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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Wrinkle Department, Western Gas Association.

WESTERN GAS ASSOCIATION,
OFFICE OF EDITOR, WRINKLE DEPARTMENT,
CLEVELAND, O., April 5, 1904.

This department is now open and ready for contributions, which will be presented at the Twenty-seventh Annual Meeting, to be held next June in St. Louis, Mo.

The active co-operation of all members and friends is earnestly solicited: Please forward contributions to the Editor at once.

W. E. STEINWEDELL, Editor.

[NOTICE.]

In the Matter of the Association Gas Congress, St. Louis.

At a recent meeting of the Committee appointed by the American Gas Light Association to arrange for a Congress of American Gas Associations, it was voted that the meetings of the Congress be held in a hall on the grounds of the Louisiana Purchase Exposition, St. Louis, Mo., on Wednesday and Thursday, June 15th and 16th, from 10 A.M. to 2 P.M. each day, and also that the government of the Congress during the sessions be vested in the Presidents of the participating Associations, the President of the American Gas Light Association presiding over this governing body, and also presiding at the opening session of the Congress.

Chairmen of sub-committees were appointed as follows:

Arrangements.—E. G. Cowdery, St. Louis, Mo.
Finance.—Wm. McDonald, Albany, N. Y.
Papers.—Walton Clark, Philadelphia, Pa.

It was decided to print the "Proceedings of the Congress," if a sufficient number of subscriptions to the volume were secured in advance.

Several of the other Gas Associations have already officially accepted the invitation extended to all of these Associations to take part in this Congress, have appointed committees to work with the Committee of the American Gas Light Association, and have contributed to the fund being raised by the Finance Committee for the purpose of defraying the expenses of the Congress. Similar action will doubtless be shortly taken by the other Associations.

BRIEFLY TOLD.

GAS ENGINEERING AS A COLLEGIATE COURSE.—Mr. John A. Britton, General Manager of the California Gas and Electric Corporation, of San Francisco, writing to the JOURNAL under date of the 28th ult., says: At the meeting of the Pacific Coast Gas Association, July, 1901, I had occasion in my address as President to call attention to the fact that the profession of gas engineer was deserving of some recognition by the colleges of this country. My suggestion provoked considerable discussion, but no action was taken. I write this in view of the approaching meetings of the different Gas Associations, with the hope that some influential member will take it up and have it fully discussed upon the floor. Nearly every branch of engineering is recognized by degrees conferred, and there seems to be no logical reason why the profession, which embraces in its requirements nearly all of the others in mechanical lines, should not have a distinction in the scientific world. I believe that if resolutions of the different Gas Associations of the United States are addressed to colleges conferring degrees, requesting that, to the curriculum of these colleges be added a course in gas engineering, and a corresponding degree be conferred upon successful students in that line, they could, at least for the present, establish such a degree and confer it upon the men in the profession who are to-day worthy of it. The recent very rapid strides made in the profession of gas engineering, not only in the manufacture but in the distribution of gas, have called out the very best talent in the ranks and have required as high a degree of scientific attainments as any other profession. While I realize to a

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great extent that titles do not always carry worth, I am arguing for this matter entirely upon the ground of the recognition by the scientific world of the distinct and honorable profession of gas engineer, and trust that this effort of mine will result in bringing about what I believe would be only justice.

OBITUARY NOTE—MR. CHARLES WATSON.—One of the pioneers of the gas industry passed away when death claimed Mr. Charles Watson, of Camden, N. J., the night of the 30th ult., at his home in that city. Mr. Watson was born in Portland, Me., 73 years ago. At an early age he moved to Camden, and there gained fame and fortune. He was one of the organizers of the Camden Gas Light Company (1854) and served it as Secretary and Treasurer for over 25 years. He resigned from its service when the Company was absorbed by the South Jersey Gas, Electric and Traction Company. At the time of his death he was a Director in the Public Service Corporation of New Jersey, and was actively connected with many other important financial and commercial enterprises of South New Jersey. He was elected to membership in the American Gas Light Association, October, 1881; but, if we mistake not, resigned therefrom some years ago. The funeral services were held at his late home, 223 Cooper street, Camden, the afternoon of the 2d inst., the Rev. John W. Lyell and the Rev. Robert H. Middleditch officiating. The honorary pallbearers were: John D. McIlhenny, Wm. E. Helme, Samuel Rudderow, Stacy Grant, Reuben H. Gaskill, John J. Burleigh, David B. Jester, J. Wesley Thompson, J. Bryan Smith and J. E. Armstrong. Interment was made in Evergreen Cemetery.

[COMMUNICATED.]

Reasons for English and American Gas Prices.

By MR. F. EGNER.

Permit me to offer a few remarks concerning the pertinent article on "Capitalization of Gas Companies," by Mr. R. W. Prosser, which appeared in the JOURNAL for April 4th, 1904. I read that thoughtful article with a certain degree of satisfaction, because I found my views on certain phases of the gas business, as given in my presidential address to the Western Gas Association, at Louisville, Ky., May, 1891, are at last beginning to be recognized, appreciated, and practically re-asserted by so able an authority as Mr. Prosser at this date. It seems to me, however, that Mr. Prosser's comparisons of American and English prices for gas are (unintentional, I am sure, on Mr. Prosser's part) quite misleading to such readers of the JOURNAL as may not be well acquainted with the relative conditions governing the cost of gas production in the two countries. Bearing upon this subject the following will probably be of interest. Six years ago, when about to visit Europe for Mr. James Green, President of the Laclede Firebrick Manufacturing Company, of St. Louis, Mo., to obtain for said firm the latest as to the progress of the inclined retort system, I was asked by Mr. John Leetch, General Manager of the Washington (D. C.) Gas Light Company, to visit Belfast, Ireland, to secure for him there such information as would satisfactorily explain why gas could be sold in that city for 66 cents per 1,000 cubic feet when it could not be done for a like figure at Washington. Mr. Leetch said that members of Congress had used these figures in argument against his Company, and he would very much like to have the facts in the case. With the consent and approval of Mr. James Green, I made the necessary detour from the trip previously mapped out, and, May 1st, 1897, had the pleasure to meet Mr. James Stelfox, Engineer and Manager of the Belfast Corporation Gas Works, in his office. Having informed that gentleman the object of my visit, he willingly gave me every possible information on the subject, which was afterwards communicated to Mr. Leetch by myself. The gist of the information was: That, although gas *was* sold at about 66 cents per 1,000 cubic feet, *the relative purchasing power* of a dollar in Belfast was more than double what it was at its best anywhere in the United States. In other words, 66 cent gas at Belfast, Ireland, was relatively dearer than $1.25-gas at Washington, D. C. Furthermore, salaries and wages paid employees (satisfactory at that to them) at Belfast, were a good bit less than one-half that paid in America for like service. Finally, while the cost of material was about the same as that obtaining on this side of the ocean, the receipt from residual products was relatively and materially greater than our companies have been able to realize. Similar conditions prevailed throughout the United Kingdom. These facts should be taken into account in connection with the statements in Mr. Prosser's excellent article; else misapprehension of *his facts* and injustice to gas companies in general may result, if the matter should be taken up in the future for serious consideration by interested parties.

[OFFICIAL REPORT—REVISED BY THE SECRETARY.—Concluded from page 529.]

THIRTY-FOURTH ANNUAL MEETING OF THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

HELD IN YOUNG'S HOTEL, BOSTON, MASS., FEB. 18TH AND 19TH, 1904.

SECOND DAY, FEB. 19—MORNING SESSION.

The President introduced Mr. H. W. True, of Boston, Mass., who read the following paper on

THE GAS ENGINE FROM THE MANAGER'S STANDPOINT.[1]

Is the gas engine of any interest to the gas manager? What position does it occupy as a prime mover; is manufactured gas a suitable fuel for it; can it be depended upon as a reliable consumer of gas, and what methods might be adopted to bring it before your customers?

These and many other questions of like nature the gas manager may well ask himself at the present time, when the trade journals abound with cuts and descriptions of gas engines for blast furnace gas, and every month new cuts appear of gas engines that the large steam engine builders have adopted and propose to put on the market in connection with systems of producers or coke ovens.

It is to answer in a measure some of these questions that the following paper has been written. In the first place, one might ask what has been done with gas engines. The report of the U. S. Census Commissioner shows that, in 1890, there were in use, in round numbers, 9,000-horse power of gas engines. In 1900 this had increased to 145,000-horse power, or over 1,500 per cent.—this represented 15,000 engines of 9.7-horse power each. By far the greater number of these engines used natural gas for fuel, and many others were operated on gasoline, and many, of course, were small engines in pleasure boats.

How many used manufactured gas for fuel I have been unable to discover; but a large manufacturer of gas engines informed me several years ago that less than 20 per cent. of his engines were used for this purpose. If these engines had all been fairly economical and used manufactured gas of average quality for fuel, and had been run at an average load of one-third their rated capacity, they would have consumed 3,600 million feet, or 60 per cent. of the gas sold in Massachusetts for the year ending July 1st, 1902.

The above figures certainly show that gas engines are here and here to stay, and if they were run on manufactured gas, their most suitable fuel, the gas companies would have quite an additional income.

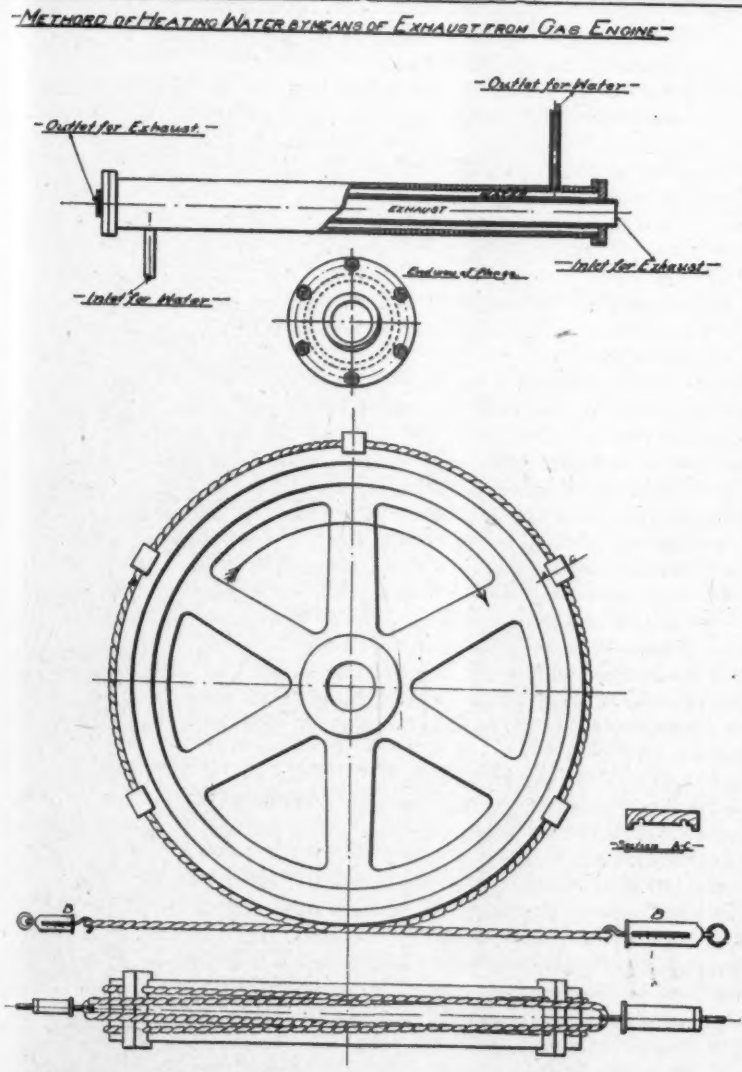
The statement above, that manufactured gas is the most suitable fuel for gas engines, is not in line with the usually accepted figures; it is nevertheless true that an engine of given dimensions, diameter of cylinder, stroke and number of revolutions, will develop more power on manufactured gas than any other fuel.

To go into all the details of why this is so would take too long and be beyond the scope of this paper; but in a general way we may say that the power developed by an engine of given dimensions depends on the quantity of fuel that can be efficiently burned in its cylinder and the amount of surface exposed to the heat of the explosion. In the case of producer and like gases the inert gases they carry occupy valuable space that make slightly worse conditions than if the dimensions of the cylinder were smaller, while in the case of gasoline the low ignition temperature prevents a small compression space and leaves a large surface exposed to the explosion. The commercial values of fuels for gas engines, aside from natural gas, which does not interest us in New England, are about as follows:

Of Gasoline.—One pint of 72° gravity is supposed to produce one brake horse power hour at full load, and it will do better under exceptional circumstances, but that is only a part of the story. There are large losses in handling, and the arrangement of pump and overflow used, even when properly installed, seems to get rid of considerable. Further, unless great pains are taken to insure perfect vaporizing, quite an amount is lost in the exhaust. An excellent proof of this is that the products of combustion of a proper mixture of gasoline and air have no odor; yet you never saw a gasoline engine that you could not smell.

With the various losses above mentioned, gasoline is an expensive fuel at present prices, and the rapid growth of the automobile industry will shortly take both gasoline and kerosene oil out of the list of fuels for stationary gas engines. Crude oil, gas oil and kerosene are good fuels for a gas engine, but as they all have to be used quite hot, an

1. The author prefaced the reading by saying, that as the paper was hurriedly prepared it did not contain all the information he had hoped to put before the Association, but that he had received some statistics from the Commissioner of Census, which he would narrate when the set paper was read.



Rope Brake.—Diameter of brake equals diameter of wheel plus half the diameter of ropes Pounds pull on spring *B* minus pounds pull on spring *B'* multiplied by circumference of brake in feet, multiplied by revolutions of engine per minute, divided by 33,000, equals the horse power.

Example.—Diameter of wheel 60 inches, diameter of rope ½ inch, diameter of brake 60½ inches, circumference of brake is 15.80 feet, pull on *B* = 75, pounds pull on *B'* = 5, net pull on spring 70 pounds, revolutions per minute are 300—

$$\frac{\text{Net Pull.} \times \text{Cir. Brake.} \times \text{Rev. per M.}}{33{,}000} = \frac{70 \times 15.8 \times 300}{33{,}000} = 10.05\text{-horse power.}$$

the hot charge occupies so much more space, a much larger engine has to be used; one-eighth of a gallon of gas oil or kerosene is claimed to develop a brake horse power by the builders of such engines; but, owing to the high temperature at which they work, they have troubles of their own. The oil question is taking care of itself, as the demand is increasing faster than the supply, and, at the present rate of increase in consumption, will soon be beyond the price of gas for stationary engines.

A first-class gas engine will develop, at full load, a brake horse power on 11,000 heat units. Taking the average low heating value of manufactured gas at 600 heat units, this is 18.33 feet per brake horse power per hour; 20 feet, or 12,000 heat units at half load, and 25 feet or 15,000 at one-quarter load. From this it is easy to figure the cost of a horse power hour at any price for gas.

I want to say in this connection that it is a mistake to take the high heating value of gas in figuring on gas engines and stoves, as the hydrogen of the gas burns to water and carries off as latent heat about 10 per cent. of the heat of the gas. With gasoline of 72° gravity, at 12 cents per gallon, the present market price, we may take the cost of a brake horse power hour with gasoline at 1.5 cents; with kerosene at 11 cents per gallon, a horse power will cost 1⅜ cents, and with average gas at $1 per 1,000 feet, 1.833 cents a horse power; but the losses from evaporation, etc., bring the cost of power from gasoline some higher than with gas; the increased cost of the engine for kerosene and increased attendance and repairs more than spoil the difference of .458 of a cent. per horse power.

We hear a good deal about types of gas engines that use fuel oils in a liquid form, that is without either vaporizing or carburetting, and at very high pressures; this type of engine is undoubtedly economical, especially at full loads, but the cost of such engines is very high; they are also most complicated; the fuels used are not obtainable in this part of the country, except in quantities, and the attendance precludes their use in small powers. Taking the same cost for fuel I fail to see where they are any more economical than any oil engine.

Another form of fuel for gas engines that is little known as yet in this country is producer gas. Gas producers can be had as small as 10-horse power, and their economy is beyond all question.

The suction producer uses no holder and occupies but little space; it requires the best anthracite stove coal for good results with the smaller sizes. Their cost at present is more than the cost of the engine which they run, and there are several interrogation points about the small ones—but from 50-horse power up they are all right, and will have to be reckoned with. They will, in connection with a good engine, deliver a brake horse power for one pound of anthracite stove coal. They require about the same attention as the engine, but not a skilled attendant.

I have shown above the fuels and their costs for the gas engine; now I wish but a word for its competitors, the steam engine and the electric motor. In small steam engines there is no such thing as economy, whether it is automatic cut-off or throttling. Under 50-horse power, on the average load of one-third their nominal rating, they will take 13 pounds of coal per brake horse power, including that to run the auxiliaries and bank fires, and maintenance of the boiler will be all of 15 per cent. of its cost per year. The excuse for using such an engine is always, "Oh, we heat with exhaust steam which costs nothing," but if the users could only see the difference in cost between using the engine for a pump to push that exhaust steam and a good low pressure or vacuum heating system, it would be a great surprise.

With reasonable allowance for interest, maintenance and attendance, there is not in New England a throttling steam engine, using steam coal for fuel and working under ordinary conditions of load, that cannot be replaced by a good gas engine with average gas at $1 per 1,000 feet and save the user sufficient money to warrant the change.

The electric motor has many good features, and is a very popular source of power; in small sizes, when first cost is an object, and the amount of power used small, it cannot be beaten; it costs about one-third as much as a good gas engine and will cost three times as much to run on the same load. At the size of 10-horse power, with an average load of one-third the nominal rating, with average gas at $1 per 1,000 feet and electric current at 6 cents per kw., the gas engine will save in one year of 3,000 working hours the difference in cost between the motor and gas engine. In a first-class engine, 25 feet of standard gas is the same thing as a kilowatt in a first-class motor.

Regarding the most profitable uses for the gas engine, I would say in general in any intermittent work, the light load losses are practically the friction of the engines which, of course, remains constant whatever the load. Machine shops have been the most successful users of gas engines; perhaps from the fact of having the attention of mechanics. Foundries find gas engines most profitable sources of power; printers seem to be the next largest users; sewing machine work comes next; and ice cream freezers take many small ones.

You may have engines now suitable to bolt up to the ceiling and drive shafts direct, or with silent chain drives or belts, in exactly the same way as electric motors; in sizes up to 20-horse power these would be air cooled, but the larger ones with water jackets will give no trouble, the water connections making some additional piping. In case hot water is any object, you may get back in this form half the heat units that you put into the engine by passing the water through the jackets, taking it out at about 160° F. and then passing it through a feed water heater, made by covering the exhaust pipe near the engine with a pipe twice its diameter and about 25 diameters long; through the annular chamber thus formed the water from the jacket is passed, entering at a point furthest from engine.

The attention required with a good gas engine is about the same as a continuous current motor, and, of course, more than that required by the multiphase motor; or I should say that the attention they *should* have is about the same as a motor *should* have, which I am sorry to say is attention they do not get in practice.

A good rule is 1 hour's pay per day to the man whose work is nearest the engine, to oil, start, stop and keep wiped up, and 1 hour per week from this man and foreman to inspect the engine and batteries and to

clean and reset the igniters. With this amount of time properly spent on an engine it will keep in good condition for a long time. I should add that the most vital thing about a gas engine is suitable oil, and the next, the source of electricity for the igniter. After trying all kinds of devices I have come back to the caustic potash battery—two sets of 4 cells each; sparking dynamos are all right but they do require attention. They wear rapidly the contact points of the igniter, and the gas that is used to drive them will pay almost for the battery renewals; finally, you have to have the battery to start with anyway. There are many devices for this purpose, but I have seen no reason as yet to discard the battery.

While there are thousands of gas engines in the country giving perfect satisfaction, there are those that do not, especially on manufactured gas; and one that gives trouble will advertise itself more than 100 giving satisfaction. I am not going into the details of why this is so, but I will suggest a remedy later. If the gas engine is worth anything to the gas man it is certainly worth a little trouble; and if gas companies will take half the pains to look after the gas engine that they do in looking after gas stoves, they will get much larger returns from the engine than the stove. Every horse power of gas engines installed will be a better customer than a first-class stove; in other words, a 10-horse power engine will consume more gas than 10 stoves, although it takes but one service and one meter. This is figured as the average load being one-third of its rated capacity and 25 feet of gas per horse power hour. The experience of several companies has been that they sell about 20,000 feet of gas per year for each horse power of engines installed.

The remedy I wish to suggest for a state of affairs that exists with the gas engine as used on manufactured gas is this: When a consumer applies for a service for a gas engine, tell him that you are most happy to connect up a gas engine, but before you do so, you want a written guarantee from the makers of the engine that it will develop the power he claims for it, and do this on a fair amount of gas; then you will test the engine before it is paid for, and see that it is as represented. This is certainly a fair thing for the three parties concerned, and will save no end of trouble. Some may think I am planning a lot of work, but such is not my intention. A brake that will give all the information you wish, as well as the most expensive apparatus, can be made up for less than $5, and an hour's work will tell you all you wish to know.

As to the reliability of a gas engine, I have a report of an English engine of 100-horse power that ran 8,760 hours in 1 year, or 96 per cent. of the time. I have heard of several that ran for several months without stopping; of my personal knowledge, an engine of 15-horse power ran 18 hours per day each working day for over a year, so loaded that it very seldom missed an explosion, and with little attention.

With intelligent attention and proper arrangements for oiling, there is no reason why a gas engine cannot run all the time with an hour's shutdown once a month to adjust the wear of the igniters for the sake of economy. As to what methods should be pursued to introduce the gas engine, I have very little advice to offer; what might be advisable for one company might be very bad for another.

A little note on the gas engine attached to the bills every month is inexpensive and will bring some inquiry. Procure a list of the users of steam engines in your city and send them regularly each month a few questions such as: "Do you know what your power costs you?" "Do you know how much power you use?" "Do you know what it should cost?" "Do you know what it would cost with a good gas engine," etc. In a few months such questions always bring results.

A few gas companies have paid some attention to the gas engine business, and while they have all had their troubles the results as far as I can learn have been satisfactory.

One company made the following statement: "We will contract for, and agree to supply power through any type of modern gas engine which merits our approval, on the basis of a fixed price per horse power delivered by the engine wherever placed, and will guarantee a saving of 10 to 50 per cent. over the present cost under any existing system of steam generation of power."

Another for some years gave a premium of $5 per horse power to anyone that would sell gas engines to be used on their mains.

Another company bought gas engines, placed them for their customers and took their pay on installments. Another company made a discount of 33⅓ per cent. for gas engines, and one other made a discount of 40 per cent.

As I said once before, these are matters for each company to arrange for themselves. It does not matter so much what you do as that you do something. The same methods that were employed with gas stoves will answer for the gas engine.

A good gas engine is still rather high priced; they are bound to be more costly than a steam engine of the same power, as the 4-cycle gas engine only receives one-fourth the impulses that the steam engine receives, although the mean effective pressure of the gas engine is double that of the steam engine.

We may look for a gradual decrease in price with some increase in economy, and a perfection of details, but we must expect no radical changes at present. Considering first cost, maintenance, attendance, economy and reliability, I believe that, in sizes from 10 to 50-horse power, the gas engine running on manufactured gas to be the best prime mover known.

A little bit of information that I got from the Commissioner of the Census here will likely be interesting to gas people. To begin with I find that the gas engines mentioned in the first part were all used for power; none of them were used for boats or anything of that kind. The entire 145,000-horse power mentioned in the first part was entirely for manufacturing purposes. Power used in manufacturing in New England by the census of 1900 was in 18,860 establishments. Those establishments used 14,000 steam engines, with an average of 72-horse power each; 9,000 water wheels, with an average of 70-horse power; 1,603 electric motors, with an average horse power of 21.64; 946 gas engines, with an average of 12.7-horse power each. Another very interesting thing in this census is that during the year 1900 there were built by manufacturers in the United States 28,353 steam engines. of which 21,806 were the old-fashioned, slide-valve throttling engines.

Discussion.

The President—We have with us a visitor whom we seldom see, who is well informed on this question. Will you begin the discussion, Mr. Lloyd?

Mr. E. F. Lloyd—Mr. President, I did not expect to be called on in this matter. It is some 6 or 8 years since I have had anything to do with the gas engine beyond operating it. At that time an attempt was made to develop a two-cylinder, double-acting engine, in order to obtain an explosion every stroke. The engine did not prove all the success that it might, possibly from other reasons than mechanical, and it was not carried further. At present I understand that the Westinghouse people are bringing out a two-cylinder, double-acting engine. It is rather a late development, and for larger powers. There has been some development, principally by the Westinghouse people, of a governor for varying the power of the charge by throttling. While I believe it is allowed that this governor is possibly not quite as economical as one in which the charge is fixed, it is claimed the greater steadiness of running at low loads compensates for the increased cost. I have heard some opinions by men who have been operating these engines that they are not sufficiently superior to warrant the increased consumption, except where extreme steadiness is required. I am operating the Gas Company at Adrian, Mich. A concern there has recently installed a gas engine of 125-horse power for running wire fence machinery, and that engine seems to be very satisfactory, using in the neighborhood of half a million feet of gas a month. The operators of it seem to think that it is more economical than steam, and I may say that they are paying $1 a 1,000 for the gas. The price, however, is on a sliding scale. If they use a large quantity it will run down. They have not yet used that quantity. There are a great many manufacturers of small engines, ranging from 5 to 25-horse power, but the majority of them give more attention, or have done so until recently, to the gasoline engine. I think, however, that the increase in price of gasoline is going to cut these out very largely. I do not think that there has been any material improvement in recent years. It does not seem that we can improve the 4-cycle engine with the predetermined mixture and intermittent full charge. We must look for improvements in engines more through improvements in the detail of manufacture and sensitiveness of governing. There are now one or two engines on the market in which this detail has been given a great deal of attention, and in which the governing is very good. Greater sensitiveness of operation is also accomplished by increasing the number of cylinders, thereby decreasing the force of each individual explosion, by higher speeds, involving, however, increased cost of construction for equal durability, and by a flexible coupling in one manner or another to relieve the driven mechanism of the shock which the impulse necessarily entails. A very interesting experiment has recently been made with a novel design of free piston engine from which some remarkable results, as high as 47 per cent. efficiency, are said to have been obtained. It is not, however, as yet a market factor.

Mr. Leonard—We have recently had some success in changing over gasoline to gas engines. We find, with the present price of gasoline and of our gas, that the manufacturer can operate a little more cheaply. We have also been quite successful in replacing electric motors. We generally can guarantee a saving anywhere from 30 to 50 per cent.

The President—It is a good beginning. If you are able to guarantee a saving of 30 to 50 per cent., it ought not to be much trouble to instal this machinery.

Mr. Witherby—The purpose of this paper seems to have been almost wholly for the introduction of the smaller type of gas engines by the various gas companies. If it is good for the ordinary parties for producing power, why isn't it just as good for the gas companies themselves, particularly when they have combination plants, which is the case with a great many of us. We have felt so firmly convinced on this that in the last year or more we have made contracts for some fairly good sized units. Last week I started up a new 250-horse power, 4-cyliuder, 4-cycle gas engine, and its initial test was exceedingly satisfactory. At present it is operating on natural gas, but our intentions are that we will first help exhaust the natural gas by using it up, and then put in producers. That is the reason it was put in in that way. We are going to use it under boilers, in fact any old way to use it up, and then go to producers later. That engine was built up with a 150 kw. generator on it, with the use of a Water's rheostat. We built up a 187 kw. on a 250-horse power engine. That gave it a pretty good load. By the operation of the main oil switch, connecting and disconnecting the load, the variation of that engine from practically no load to almost full load; the variation was less than 1 per cent. It so happens that the engine is belted first to a line shaft, which is to be run in conjunction with other steam units now in the building, and then belted back to the generator, and the action of the belt, from the time the switch was thrown connecting and disconnecting the load, was almost absolutely steady. In my experience of starting a new unit, I never have seen a steam engine that would handle a load as successfully and with as little variation as this gas engine has done. We have felt so well pleased over that one installation that we recently closed a contract for a 1,400-horse power engine. That is also a 4-cylinder, big engine. If that one proves successful we have an installation now figured out for four 1,400-horse power engines, running on producer gas; by-the-way, for a New England installation.

Mr. Snow—One statement was made here that a year ago I should have believed implicity, but since that time I have had occasion to do some figuring, and I cannot quite subscribe to what is stated here; that is, as regards the small sizes. The author states that the first cost of an electric motor would be perhaps one-third that of the gas engine, but the cost to run would be three times as much. He states his price, basing that statement on a price of 6 cents per kilowatt. Now, there are places that will sell current for power for 2½ cents, even 2 cents, per kilowatt, and in such cases they are selling their power as cheap and cheaper than dollar gas. I simply speak of it so that every gas man would not make the statement with all the confidence in the world that he was making it correctly, that he could beat out electric power with his gas, without knowing what they were selling electricity for per kilowatt.

The President—Mr. Baldwin, will you add to this data as to the practical care and oversight of installations already made, and as to selecting an engine?

Mr. Baldwin—Mr. President, I don't know there is anything special I can say on that subject. I think Mr. True's paper is an excellent one and worthy of the careful attention of every gas manager. One thing mentioned that I want most heartily to indorse is the matter of gas companies taking up, and securing in behalf of their customers, a guarantee from manufacturers of gas engines as to what the brake power of the engines will be. My experience has been that a large proportion of the people who come to me to talk about gas engines tell about what they can buy an engine for, how little money, and how much power it will develop; but they seem to have absolutely no idea of what a 10 or a 15 or a 20-horse power engine is. The result is that they buy an engine on the basis of dollars and cents, instead of quality, and on the statement many times of irresponsible people. The engine is put in and set up. It won't do the work which they bought it to do. It will not develop the power which they were told it would develop. The result is they immediately become dissatisfied. It has the effect of practically killing the interest of other people in their vicinity who would put in efficient gas engines. The man has nothing good to say for the engine, he feels that he has been imposed upon, and in that way a large amount of business is lost to the gas companies. Now, if the gas companies would take that matter up, interest themselves and advise their customers as to what they ought to obtain in the way of power, what guarantee they ought to obtain before they bought an engine, I think it would help the gas companies very much to increase this class of business. In regard to the matter of the cost of installation. The price of the gas engine, of course, seems and is high as compared with the steam engine; but in comparing the prices of the two the man usually does not take into account the item of a boiler for his steam engine and its installation, which should be figured as a part of that plant as much as any part of the engine. Another thing, and, perhaps, one of the most difficult to accomplish, is to induce people who put in gas engines to have some one man responsible for the care of the engine, instead of having three or four, and also to get a man to care for the engine who will do what the manufacturers of it think is necessary—a few very trifling details, so far as attending to the engine is concerned, but which, if omitted, will make the operation most unsatisfactory. Another difficulty encountered is the man who, when the engine is started up, sees where the manufacturers have failed in some essential feature, and immediately sets about to correct it, with the usual result that the engine begins to give trouble, and does so as long as that course of procedure is followed out. We had in the city two installations in one place which gave a good deal of trouble, simply because the man who had them in charge continually wanted to improve them; but after he had been supplanted by a man who was willing to let the engine alone after it had been put in proper shape everything went along smoothly. Another feature in regard to the gas engine, that ought to appeal to people who are thinking of using power, aside from the fact that the economy of the gas engine is beyond all dispute, is that the engine is a much better asset than an electric motor. A man can move his engine from one place to another. He can move from Boston to some suburban town and take his gas engine along with him, and it is just as good in the town that he goes to, if he has gas, as it is here; whereas if he has an electric motor it may not be good for anything for his purposes in his new location. The gas engine business, I think, is going to surprise even gas men who have given it a good deal of attention. The inquiries are very numerous indeed, and if the gas companies would offer inducements to people to put in gas engines, either by putting them in themselves, as some gas companies do, and allowing customers to pay for them on the installment plan, or any other basis that might seem advisable, I think they would find their consumption of gas very largely increased, and it would be a very profitable investment for them.

Mr. Price—I think there are about 20 gas engines in New Bedford. They are giving very good satisfaction.

The President—What average size?

Mr. Price—About 2 to 20-horse power. Average about 5-horse power.

The President—And in Lowell, Mr. Hintze?

Mr. Hintze—I would like to defer the story of the gas engine till another year. We have two units of 100-horse power each that we propose using in the new installation retort house. I think another year we can give you pretty good figures on their work. We have installed quite a few, I can't call to mind just now how many, engines through the city, but they are working out their own salvation in a good way.

Mr. Gould—I cannot give you the exact number, but it is gradually increasing. We have put in 30 or 40, perhaps within the last 2 years. I cannot give the exact number to-day.

Mr. Nutting—We have installed a number of engines in Chicopee, and I know of several in Springfield and Westfield that are giving very good satisfaction. One engine particularly that I have in mind now has run for over 4 years constantly, 10 hours a day, on about full load all the time, and I think that the only expense was, about two months ago, putting in a new set of rings.

The President—Have you ever had an engine discontinued in its service?

Mr. Nutting—No, sir.

Mr. J. J. Humphreys, Jr.—I have not yet made any large installations. I have several on the string, one of which is 450-horse power, in 3 units. That is almost absolutely sure to go through. But I am almost afraid to advocate the present gas engines for fear the gas turbine will be completed and I will be out of it. Can anybody tell me whether any gas turbines are in use?

Mr. Barnes—We have 10 or 12 gas engines in use. So far as I know they are giving very good satisfaction. We occasionally have inquiries for new ones.

Mr. Scranton—We have hardly any gas engines at present. They have been replaced by electric motors.

Mr. True—There are two or three little things to which I would call your attention. Regarding the remarks of the first speaker, as to the methods of governing, of course, all my remarks have been about hit-

or-miss gas engines. The reason why the hit-or-miss gas engine is so popular is that its thermal efficiency is as high on a light as on a heavy load. Throttling engines have one disadvantage—those engines particularly which throttle, have a constant mixture but throttle that mixture. Take one of those engines, and it will do just as good work on a full load as any gas engine will, but running idle it will take 40 per cent. of the gas that is required to run it at its full load. That is the great trouble with it, inefficiency on light loads. At the present time there are probably 100 4-cycle engines built to one 2-cycle; that is engines of any size. There are the little boat engines, and also some automobiles are made on the 2-cycle principle; but, of course, with a great many people experimenting, and a great deal of money being spent at the present time in perfecting gas engines, I don't think there is any doubt that inside of a few years you will have the 2-cycle engine replacing the 4-cycle, because the same weight of engine of the same dimensions should give twice the power. I am sorry to say, with all the 2-cycle engines I ever had anything to do with, I could get just as much power out of them, out of the same dimensions, by making them 4-cycle as I could by having them 2-cycle. Even then there was an advantage in the 2-cycle engine, from the fact that you have two impulses instead of one. But at the present time a hit-or-miss 4-cycle engine is much the best proposition for all ordinary work. Of course, if you have a machine that you can load and keep somewhere near loaded, the throttling engines are all right. I can say also that hit-or-miss engines are purchased in this country the makers of which will guarantee a regulation within 1 per cent. Of course, the flywheel is quite heavy, but the efficiency of the engine is high. Now, in regard to large gas engines. I took a position in this paper regarding size where nobody can throw me down, and that is between 10 and 50-horse power. My point is simply this. A gas engine on manufactured gas is a good proposition from ¼-horse power to 5,000-horse power—there is no trouble about that; but my point is that from 10 to 50-horse power the gas engine on manufactured gas has got an unassailable position. You cannot throw it down by any kind of power. The man buying the engine looks at its first cost, I don't care what engine it is. At this present time three-fourths of the steam engines in use in this country are throttling engines, the engines of our great-grandfathers. It is not economy, of course, that makes this so, because it takes four times the fuel to run it that it does to run an automatic engine under usual conditions, but it is because of the price. You can buy a 50-horse power throttling engine for $450, and a 50-horse Corliss will cost $850. One takes four times the fuel that the other does under average conditions of load, but the price is what sells it. So in small gas engines the cost of the engine is some object. That is where, below 10-horse power, the electric motor comes in. It is the first cost they look at. Another thing. My experience has been that the small engine is unsatisfactory to sell. It requires just as much battery power and just as much attention in a 5-horse power as in a 50-horse power. In regard to the price of electricity, I am aware that there are in New England electric companies selling electricity for power for 2½ cents a kilowatt, but I am going to say right here that there is not an electric company in New England that can make a kilowatt and deliver it to their customers for 2½ cents, and use steam coal for fuel. Regarding the gas turbine. A gas turbine is in existence, and a nice one too. Some Frenchman has got it on an automobile. It is worked by the exhaust from the engine, and drives a little fan to keep the cylinder cool; but beyond that you don't need to look for a gas turbine for quite a while. In regard to producers. I don't think the gas men should worry about any competition from electric motors, but one thing that you have soon to face is competition from gas producers. There are at present two companies represented in New England that are selling gas producers of suction type, that require no holder. They are very simple. They run in size from 5-horse power up. I don't know what economy they guarantee on the small ones, but say from 25-horse power up, those producers, on coal of 14,500 heat units, will put 80 per cent. of the heat of the coal into gas. Most of the small ones use stove coal, but I should say that above 50-horse power it would be safe to run them on pea coal. There is the competition that we may expect in the future. I don't doubt that inside of a few years every boiler shop in the country will be building a gas producer. But even so, with a lower cost of operation of the gas producer outfit, I still think that below 50-horse power the manufactured gas engine has the best position, on account of the first cost. So I think that it stands the gas companies in hand at the present time to just pay a little attention to the gas engine.

Mr. J. J. Humphreys, Jr.—I have it very credibly that a number of people are working very hard on the gas turbine end of it, but the particular one I wanted to know about was the one shown at the Worcester Polytechnic School some three or four years ago, which I have not been able to trace up since then.

Mr. Lloyd—Might I add a word, suggested by the remarks that have been made here. I do not think it is of much consequence that the manufacturer should guarantee the *power* of the engine, because I consider that to be ascertainable without any particular trouble by the gas company. Engines of the same diameter of cylinder and approximate length of stroke will produce the same power, provided they are mechanically equal in their construction and equally operated. Consequently the *claim* of a manufacturer or any other will be of no consequence, provided, as I say, engines have the same diameter of cylinder, approximately the same stroke, and are run at the same number of revolutions under the same compression. If one man will run an engine at 190 revolutions and claim that it is 15-horse power, and the next man will run the same sized engine at 250 revolutions and claim that it is 19-horse power, there is no necessity to take his statement for it, and he is correct, if you choose. One of the most important points, and one which is frequently overlooked, is the actual construction of the engine. The gas engine is a heat motor in a certain sense, but it acts by a tremendous initial pressure, running down to atmosphere, or practically atmosphere at the exhaust. It is, one might say, exploding a small charge of dynamite and getting the power from it. Now, then, an engine to be durable and to be efficient must be very well constructed in the first instance, and it should be constructed in the most direct manner. There should be no complication about it. The bearings should be very heavy, and they should be properly distributed. The valves of a gas engine have to deal with high temperatures. They should be plain mushroom valves of the simplest possible description. There should be as little as possible of bearings where the hot products may affect the metal, and where they cannot be lubricated. The water chambers around the cylinder and around the ports should be so thoroughly accessible that they can be cleaned out, because the water will deposit more or less sediment, and unless you can remove the rear head, we will say, and get access to all those interior ports, you will speedily have trouble owing to sediment accumulating. As a result, the lower portion of your cylinder, let us say, will not be properly cooled, it will overheat, it will burn the lubricating oil, and your engine will give trouble. Gas engines will run almost continuously. They will do just as well as steam engines in that respect; but the lubricating oil, as has been mentioned, is one of the most important points. It must be such that it will not carbonize under the ordinary temperatures, and it must not be so heavy that it will gum under those temperatures, in other words, distil out any light products that might be in it, and leave a heavy gum residual, which would promptly stick up the rings, prevent their acting and very shortly after stop the engine. It is necessary for the gas company itself to have some man in its employ who is capable of rectifying the troubles with gas engines. It is just as much so as it is to look after arc lights, and I don't know but more so. The ordinary operator of a gas engine is entirely at sea when anything goes wrong with it, and anyone who has had experience with engines will know that they may be seemingly in perfect order and yet they won't run; some simple little thing is out of the way which the amateur cannot detect. A very large Western company, which has made a considerable success of installing gas engines, has a corps of men whose whole duty is to inspect these engines with reasonable regularity, and they are exceedingly successful, and are a source of marked revenue. From Mr. True's reply, I think possibly he thought I was advocating the variable charge type. I don't take stock in engines of that character. I merely referred to them as being heretofore the largest American built engines. We have never improved for efficiency the 4-cycle hit-and-miss governor with the fixed charge and compression, and in my own belief it is not going to be improved for at least some time. It seems that it is necessary to mechanically scavenge the cylinder and to previously determine the exact mixture. Now, if you are going to mechanically scavenge the cylinder, it can only be done by displacement, and that means an idle stroke. For that reason, the 2-cycle engine is not an economical machine, and has never been wholly successful, and I know that a large number of manufacturers of even very small machines, such as for automobiles and motor boats, are going to the 4-cycle engine in preference.

Mr. True—I just wanted to say one thing. I can indorse almost everything Mr. Lloyd has said; but one thing that I simply can't is that the same dimensions of engines—I don't know whether he said will—give the same power or should give the same power.

Mr. Lloyd—Should.

Mr. True—But they don't.

Mr. Lloyd—That is through mechanical differences of construction.

Mr. True—It is not that so much as it is two other things, ratio of cylinder diameter to stroke and compression, which things have a tremendous influence on the capacity of an engine; in fact, that is the whole thing. I know of engines in the city of Boston to-day, of the same diameter of cylinder and stroke, or running the same piston speed, we will say, one giving twice the horse power that the other does. It is merely a case of proper construction. One great reason why gas companies should take a hand in this thing is that a great many makers have an engine which they advertise in their catalogue can be changed from gasoline to gas while it is running. Well, if it can, and it will run on gasoline, it is the most confounded poor gas engine on this earth; it will eat more gas than anybody wants to pay for. Another thing: Take a gasoline engine of 20-horse power, that can be changed from gasoline to gas while running, and I will guarantee you cannot get 15-horse power out of it on the best gas they have in New England; it is not in it. It is not in economical shape. There are too many engines like that. Within the last few weeks I have run up against several cases where it was merely a gas engine with gasoline compression, 52 pounds compression, and explosion pressures of 180 pounds where it should have been 400. The dimensions were all right, except that gasoline engines don't have the pressure; they don't have the temperature which a gas engine does. So a great many engines that run very nicely on gasoline start to give trouble the minute they are turned on to gas. Not but that gas is a good fuel for gas engines; it is the best fuel; but the conditions must be proper for it. An engine run on manufactured gas must have good valves and everything about it in first-class shape. The temperature and the pressure are much higher. My experience has been that it is very necessary for the gas company to have a hand in the horse power which an engine develops, and I have had some bitter experience to prove it. I started out with the idea that a certain dimension of cylinder should give a certain horse power. I figured, after figuring over several engines of pretty good make, that 70 pounds per square inch mean effective pressure on the piston of a gas engine would develop its brake horse power. I found out pretty quick that we were getting terribly left. We were working engines that would not begin to develop it, and there was immediate trouble between the builder of the gas engine and the gas company. My idea of getting out of those troubles is to have the gas engine builder guarantee the power. He ought to do it. He should also be willing to do so on a fair amount of gas. Then the gas company knows that its customer is getting what he pays for, and it will save all kinds of trouble. Another thing: Such an arrangement as that simply stops installing a gasoline engine to run on manufactured gas. There are gasoline engines that have been recently installed in Boston to run on manufactured gas that have given all kinds of trouble. The bills were just twice what they should have been. That hurts the business; it hurts everybody. It is to avoid such things as that that I advocate the gas company seeing that those engines do develop their power, and that they do it on a fair amount of gas. I would make another suggestion. Get the people that sell the engine to test it in the presence of one of the gas company's men and prove that it does what is claimed for it. That will be the best way. Another thing that is certainly the very best thing the gas company can do is to have some man connected with it able to go around and adjust a gas engine when it gets out of order. There are a few simple little things that probably create all the trouble with the gas engine. The matter of oil is one of the most vital things. Any oil will burn when it gets in a cylinder where the explosion is, but the point about it is that it should not have a paraffine wax body, it should not when it burns leave something behind it, it should burn up clean. There are oils which will do that and save a great deal of trouble.

The Secretary—Mr. President, I don't want to choke off discussion but the hour is getting late. I would like to move a vote of thanks to Mr. True for his paper, because I think the subject is an important one. I might add to my vote of thanks by saying that I asked him to write this paper because I wanted some of the information that he has brought out for use in my business. [Adopted.]

The President announced that the

COMMITTEE ON GAS CONGRESS

would comprise Messrs. F. S. Richardson, W. McGregor, W. G. Africa, W. A. Learned, J. A. Coffin, A. K. Quinn, J. E. Nute, H. A. Norton and N. W. Gifford.

ADJOURNMENT.

The President—Is there any further business? Has anyone any further business to bring before the Association? If there is no further business, a motion to adjourn will be in order.

A motion to adjourn was adopted.

[REVISED BY THE SECRETARY.—Continued from page 531.]

TWENTIETH ANNUAL MEETING, OHIO GAS LIGHT ASSOCIATION.

HELD IN THE HOLLENDEN HOTEL, CLEVELAND, O., MARCH 16, 17 AND 18, 1904.

FIRST DAY—MARCH 16.—MORNING SESSION.

The President introduced Mr. J. J. Knight, of Kalamazoo, Mich., who read the following paper on

THE USE OF HIGH PRESSURE GAS IN STREET LIGHTING.

All things considered, the most efficient, satisfactory, and, therefore, most generally adopted street lighting system in use to-day is probably that furnished by the use of the so-called 2,000-candle power open electric arc lamps, hung from 20 to 30 feet from the ground and in the center of the street intersections the long way of the block and alternate intersections the short way of the block.

The lamps so placed are usually about 500 feet apart, except in what may be called the police districts, where they are placed somewhat closer. A better system, except for the matter of expense, would be the use of the inclosed electric arc lamps placed, say, 200 feet apart on alternating sides of the street, hung from 12 to 15 feet high.

There may be earnest gas men who will not agree with these statements, and who believe that single mantle gas lamps of the modern type placed at short intervals are more satisfactory. It is possible that such would be the case if they were frequent enough, were well maintained, and were not subject to disability and damage from frost, wind, bugs, etc., and the cost of installation, operation and maintenance did not exceed the cost of electricity.

I am quite sure as a general proposition, the electric light is more favorably regarded by the average citizen not interested in gas, and it is probably not wise to let our enthusiasm lead us astray in this matter. As Mr. T. D. Miller said at the American meeting, "It will not do to fool ourselves."

We are all familiar with the many objections to the electric street light, with its frequent outages, great variation in average spherical and maximum candle power, heavy shadows, lack of volume of light, objectionable and dangerous line construction, etc., and it would certainly be greatly to the advantage of the business we represent if a system of lighting streets with gas could be devised which would overcome the objectionable features of all the present systems, and at the same time apply what has been said to be the first consideration in any system of street lighting, viz.: "To give the public the impression of well lighted streets at a small or reasonable cost."

There is no doubt there exists a demand for this, a sort of underground growl, which goes along with the general belief that there is nothing better; but let something better appear and this demand will burst into a clamor at once.

Ever since Mr. Shelton surprised us all by his paper on "High Pressure Gas," read at the Western meeting, held at Milwaukee some time ago, it has seemed to me that in some way we should solve the question of ideal street lighting by this means, and during the last year and a half I have given the subject much thought, made many experiments, and I am frank to confess, met with some severe disappointments and surprises, not the least of which was within the last few weeks, and which was in the nature of a telephone message to our Mr. Blinks from Hammond, Ind., where high pressure distribution is being used, and which stated that their experience there this winter had not borne out their previous experience or the opinions held and expressed by their Mr. Goodnow, of Waukegan, viz.: That high pressure eliminates troubles from moisture and frost. The Hammond Company is operated by what is known as the Dawes Syndicate, who have done more with high pressure distribution than any other operators of whom I have any knowledge, and who have it in use delivering gas directly to the consumers at Waukegan, Hammond, Chicago Heights and Blue Island, and at other points for use in reinforcing low pressure mains.

On receipt of this information our Mr. Blinks visited Hammond, and found that a number of services which had been laid without regard to grade have given endless trouble, and it was said all these would have to be relaid. I then wrote Mr. Goodnow, asking if he had any explanation of this or if he had changed his mind. Up to the date of writing this I have not heard from him, which is due, I think, to his absence from home. I assume, however, that there is some explanation and trust that Mr. Goodnow or some other member will be at the meeting able to give us the interpretation of the trouble.

Considering, therefore, the possible undeveloped difficulties with high

pressure gas, and but partially developed plans for the street equipment, I feel, as I wrote our Secretary, Mr. Jones, when he asked me to say something on this subject, that there is so much I know but little about with certainty, so little that I know all about with certainty, and so much I probably know nothing about, I have prepared this short paper with a good deal of reluctance.

I have, however, determined some things, and the weight of my observation and experience justifies me in the belief that we will be able to again light streets with gas far better, and at least at no greater cost for operation than is now being done with electricity, and that the most important factor will be the use of high pressure distribution.

In order that attention may be drawn to the subject and discussion aroused, I will say that in my judgment the method will be worked out on about the following lines: In cities up to say 25,000 to 30,000 people the distribution system will consist of 1-inch to 1¼-inch services, radiating from a central station, to which the gas after having been metered, will be piped from the gas works in a large main and under high pressure.

Each service will supply lamps on, say, two miles of streets. They will be laid very shallow and inside the curb except where they cross the street. The posts will be ornamental and attractive in appearance, and will be placed on alternating sides of the streets, about 300 feet apart. The lamps will also be ornamental in appearance, of high candle power, equipped with metal anti-vibrators, and scientifically designed reflectors. They will hang suspended slightly out from the post, and about 12 feet from the ground on the ordinary 66-foot street. They will probably be 3-mantle lamps. They will have to be so constructed as to be wind proof, not affected by the elements, and able to resist very high temperatures (one of the most difficult preblems in connection with the wind proof lamps operating on high pressure gas).

The gas will be turned on and off from the lamps at the central station by means of the pressure, which, when the lamps are not in use, will be normal. The lighting will be accomplished by the use of pilots, which will burn constantly a small amount of gas. To maintain this pilot at a uniform consumption of gas is another difficult problem, and may possibly require another and smaller service, though I think not. In any case the cost would not be excessive and could not much exceed the bare cost of the pipe. The services will probably be laid in tar concrete and boxed, and will be practically everlasting.

I have given you the details of the lamp construction as fully as I can at this moment and in its present state of development. By attempting to be more explicit I might mislead others who may have worked or may hereafter work along these same lines, but I can say with confidence I think that the lamps will not have any hot air engines or very long chimneys connected with them, as I believe I have demonstrated the impracticability of these, at least to my own satisfaction.

What has been said completes the plant for cities of the class mentioned. For larger cities, larger services or more stations will be provided according to the economies in the case. Considering the comparative costs of construction, I estimate that the services, post and lamps will cost about 30 per cent. more than the line, pole and lamp construction of the electric system. The cost of maintenance and attendance will be very materially less. I think the whole costs of operation, including the gas, will enable gas companies to make 10 to 15-year contracts to install the plant and operate it at a price for light not exceeding the costs of light which are now made by the best managed municipally operated electric plants, and at this price get back the cost of the plant and a satisfactory profit on the gas during the life of the contract. The contract will provide for extensions of the plant from time to time at the city's expense during the term of the contract, and at its expiration the plant will become the property of the city in case a further long contract is made for a supply of gas by the company at reasonable rates.

The advantages of this system of lighting can scarcely be estimated. Services underground, out of sight and safe, in place of dangerous and obstructive wires, attractive iron posts instead of unsightly and short-lived wooden poles, the light uniform, constant and of an efficiency never approached heretofore, and by a system so flexible that it will be possible to operate it on the moonlight schedule and have light at a moment's notice whenever needed, and at the same time realize all the economies possible in the case, a thing which is wholly impractical with the electric system.

High pressure distribution will be the most important factor in the operating of this system. I depend upon it for eliminating the frost problem, for cheapening the cost for construction, for the turning on and off at a central point, and, so far as it is important, in giving light efficiency. I am so confident of its success that I am going to ask the city of Kalamazoo to allow me to light a street as soon as I am satisfied with my lamp construction.

The city is now operating its own electric plant, and I believe it is the best and most economically lighted city with which I am familiar, and yet the City Council has within a short time submitted to a vote of the citizens a proposition to abandon the plant and contract with a private corporation—this before the bonds were paid which were issued to install it; and the proposition would have carried if the bidding company had made any kind of a decent offer to take over the plant. But they made none, and even we, who are most opposed to municipal ownership, were obliged to vote against the proposition in self-defense as taxpayers, as we could not stand for a total depreciation within less than 10 years. If I can meet their costs as easily as I can excel their light efficiency I shall indeed be gratified.

On finishing the reading of his paper Mr. Knight explained: In this paper I note that I wrote Mr. Goodnow, asking if he had any explanation as to the trouble encountered by his Company at Hammond, stating that I did not receive a reply. Since the paper was prepared I heard from Mr. Goodnow and Mr. Johnson; the latter is the Manager at Hammond. They stated they concluded they had not made the proper arrangement for taking out the moisture after compression at the works, and thought they would not have had any trouble if they had done so.

Discussion.

The President—The paper just read deals with one of the newer topics in the gas business and we would be glad to have a full discussion. We want everybody to understand that each and everyone is entitled to the floor, the new members as well as the old.

Mr. Schwarm—I would like to ask Mr. Knight if, in his experiments he found that the 3-mantle lamp, burning under high pressure, would give as much light as one of the later types of inclosed arc lights? He refers particularly to the 2,000-candle power open arc. It is generally considered now, I believe, in the street lighting field that the inclosed arc lamp is superior, and I would like to ask if his experiments were based on a competitive light; either the open arc or the inclosed arc? Of course, if we should attempt to place that system before the public, we should at least meet the expense of the electric arc, and also be able to furnish the same amount of light. It is a question in my mind whether the 3-mantle burner would give the same light as the inclosed arc of the alternating type.

Mr. Knight—I expect the 3-mantle lamp, distributed as I have suggested, will give a better light for street lighting purposes than any electric arc. In my experiments I have compared it with the open arc, because my understanding is that they are a much stronger light than the inclosed arc. That is to say, I understand the inclosed electric light loses somewhere about 40 per cent. of its light by being inclosed. That has been my experience.

Mr. Schwarm—I think any experiments on that line should be made in comparison with the inclosed type of arc light to-day, because the inclosed type is rapidly displacing the open arcs on account of cost of operation and the expense incident thereto. The question of the superiority of a light, as between the open and closed arc, is an open one in the electrical business, but inasmuch as the inclosed arc is becoming more popular every year, I think the comparison should be made on that basis.

Mr. Warmington—I would like to ask Mr. Knight how much pressure he carries, when he speaks in his paper of a high pressure line. What pressure do you have on the burner?

Mr. Knight—Well, not very much. I do not get an increased light efficiency on pressure above 5 or 6 inches on the burner. Of course, we carry a much higher pressure on the line.

The President—The system of high pressure lighting has advanced much more in Europe than it has here. I believe in Manchester, England, there is a system of high pressure lighting which is giving very satisfactory results. Mr. Doherty, have you anything to say on this subject?

Mr. Doherty—I do not know that I have anything to say, Mr. President, on this subject, except that I for one would like to encourage Mr. Knight to continue his experiments. He is working along a most promising line, to my mind, in the development of gas street lighting. I believe high pressure for mantle lighting makes the efficiency of the lamps sufficient to compete with any of the present forms of electric street lighting. I was rather interested in the discussion between Mr. Knight and Mr. Schwarm regarding the inclosed and open arc systems of street lighting. Mr. Schwarm spoke of the fact that the inclosed arc lamp is rapidly superseding the open lamp. It is doing that, in

spite of the fact that the total light per watt consumed is much less. If you want to get positive data on that subject you will find it in the "Proceedings" of the National Electric Light Association in several reports of the Committee on Arc Lamp Photometry. These reports are standard the world over now, and you can get figures that would be safe and accurate for comparison with gas lamps or any other form of illumination. I think you will have a greater competition from other forms of electric street lighting than from the inclosed arc lamps, and that we should keep in mind the fact that we have to do something better than to beat the inclosed arc lamp. The series open arc lamp, were it to be operated upside down, with a properly designed reflector, would to my mind, undoubtedly give very much better results than could be secured by the inclosed arc lamps. I think, in spite of the fact that the Nernst lamp does not give as high an efficiency as is ordinarily claimed by its manufacturers, when considered as a source of light in every direction from the lamp, it can be used in smaller units, and as the light decreases in reverse ratio to the square of the distance the minimum illumination is perhaps greater, for the same consumption of watts, than any form of arc lighting, even though the total flux of light is less. The Cooper-Hewitt Mercury Vapor Lamp, I believe, is the most promising lamp for street lighting at present; but if I was competing for a street lighting system myself, I think I would prefer to use some system of smaller units, either the Nernst lamp or something of that sort in preference to the inclosed arc lamps, and I would be much inclined to the Cooper-Hewitt Mercury Vapor Lamp for street lighting purposes. We have to do something better than compete with the inclosed arc lamp, and while we are able to secure a great deal of street lighting with the ordinary incandescent gas lamp, we may have a harder time to do that in the future, unless we increase the efficiency of the incandescent gas lamp. Therefore, perhaps Mr. Knight is doing better work for the gas fraternity than anyone of us appreciates just now.

Mr. Stone—One bright spot in Mr. Knight's paper to my mind is the idea of independent control of his street lighting, regardless of the distribution of gas for other purposes. I have thought some about entering into competition with electrical companies for lighting streets by gas. In fact, not more than a year or so ago, I bid against an electric light company for the privilege of lighting the streets of our city. I did not win out simply because of the glamor that there is surrounding electric street lighting. For some reason, and you know it as well as I do, the people as a whole think that electric lighting is better than gas for street lighting purposes. While you might make a proposition that would be cheaper it would be hard to convince the people of that fact, and you have to make it so much cheaper and present its advantages in such a way that it will leave no possibility of doubt along that line. One of the causes which has operated against a gas company competing for street lighting, especially where the streets cover considerable territory, was the idea that you had to light every lamp separately and have a gas lamp lighter, and if you wanted to operate on a moonlight schedule you would have to call your man out at almost all hours of the night in order to do it. For that reason Mr. Knight's paper has interested me very much. Now with all gas men it finally comes down to the question whether or not it pays. If you figure that you can get a contract for 10 or 15 years, you have to put a separate plant in for the carrying out of the contract, and you have to figure that your plant will be of no use to you for anything else at the end of that period. You have to allow for that in your estimate of cost. Then it is somewhat of a question with me whether the mantles and the apparatus required in such high pressure street lighting do not depreciate more per light unit or per candle power or per cost of unit in operation than they do in low pressure lamps. I know that a mantle working on four ounces, which is about 7 inches pressure, with natural gas depreciates much more rapidly than a mantle working on 2 or 3 inches pressure with artificial gas. The heat is more intense, the mantle gives out quicker, and the rest of the lamp burns out more rapidly. There is a question whether the cost of maintenance of a high pressure lamp would not more than offset the increased efficiency of the lamp. These are all questions in my mind which should be worked out from actual experience. I am sure we are all all glad to have Mr. Knight work them out, and we would all be very much pleased if he could demonstrate it a practicable success. As I said before, I think the best feature in the whole arrangement is the idea of independent control of street lighting.

The President—Any further remarks on this subject?

Mr. Butterworth—Recently the *Journal of Gas Lighting* made the statement that, at some place in England—I cannot now remember where—a system of street lighting was in successful operation where the lighting and extinguishing of the gas street lamps were done by means of raising and lowering the pressure. It is a system that has been tried and thus far has been successful.

On motion of Mr. Schwarm, a vote of thanks was extended to Mr. Knight for his valuable paper and the information contained therein. The motion also included the request that Mr. Knight prepare a further paper on the same subject after the experiments now being conducted at Kalamazoo had been completed.

The President—Unfortunately, as Mr. H. L. Rice, of Norfolk, Va., the author of the paper on

ECONOMY IN OXIDE PURIFICATION,

was unable to attend the meeting, I will ask Mr. Schwarm to read it.

Mr. Schwarm read as follows:

Given good, well made oxide, the questions that enter into purifying economy are mainly those concerning box area, construction and arrangement, and the method of handling the material. What relative area and depth in our boxes shall we insist on; how many boxes in series; shall we use air or not and how much and where; shall we regenerate by drawing down (or blowing up) through the box, and (more recently) shall we reverse? These are a few of the very practical questions that are being asked, and which call for an answer whenever a change in purifying arrangements is projected. It is the writer's desire in this article merely to call attention to some results in purification achieved under rather unusual conditions at the Norfolk (Va.) works, and to suggest a possible bearing they may have on the answers to the above questions.

The new purifying house at Norfolk was placed in commission for water gas, January 1, 1902. The coal gas was continued through the old house. The new water gas boxes are 2 in number, 16 by 20 and 7 feet deep, flow divided up and down through two 3-foot layers of Connelly iron sponge, and valved so that either box may be used first or alone. Provision is made for addition of a third box. The water gas is well condensed before reaching the house, and passes through an 8-foot, 2-story shaving scrubber before entering the boxes. No trace of oil has been found in the scrubbed gas. Conditions permit an excellent degree of regularity in the pumping of the water gas throughout each 24 hours. The maximum hourly pumpage has not exceeded 20,000 cubic feet in the past 2 years, while 15,000 is a nearer winter average, falling below 10,000 in summer. The house has, therefore, been used at $\frac{1}{3}$ to $\frac{1}{4}$ capacity, and it is rated equal to 800,000 feet per day, not estimating the divided flow quite as efficient as the double area 1-way. The top outlet of each box is equipped with a wooden slide to regulate the division of the gas, and the effect is watched by top and bottom test cocks. The boxes have been *reversed* regularly, in action *once a week*, the second or clean box being put first. A change of oxide has been considered necessary only when the second box would not clean up, the first box fouling and the second remaining so. No revivifying air was used the first year, but this was injected the second year at the exhauster, except for part of the summer, in amount not averaging over $\frac{1}{2}$ per cent. Three batches of oxide of 1,500 bushels each have been used in rotation, and the oxide was all absolutely new at the start. The results in these boxes for the past 2 years are as follows:

All new material, first filling: Boxes ran from January 1, 1902, to March 1, passing 13,985,000 feet. Box A changed. Boxes ran from March 1 to May 21, passing 16,176,000 feet.

Once used material in B. Condition of A governed. Box B changed. May 21 to September 23, passing 22,717,000 feet.

Material once used. Box A changed. September 23 to December 9, passing 21,354,000 feet. Box B changed, December 9 to November 23, 1903, passing 87,752,000 feet.

No change since November 23, and at this date, February 1, 1904, boxes doing well. Air was used after January 1, 1903. It was seen by the action of the boxes then that results would not further improve without it.

When the boxes were started the first box showed foul in one week. The alternative of reversal would have been emptying or regenerating. Reversal without air ran the boxes as above.

It will be noted that there was only one change in this house in 1903. The total labor for the year was $25, or $\frac{3}{16}$ of a mill (.03 cent) per 1,000. There is no special method of handling the oxide. It is dumped out of the boxes and hauled up and thrown in by hand.

The coal gas purifying house consists of 4 shallow boxes, 14 feet square, with the old style center seal. These boxes allow a 2-foot layer of oxide—Connelly sponge. Beginning January, 1903, the system of weekly shift was introduced into this house also. After considering

possible alterations in piping, the simple plan was evolved of pushing the center-seal one box ahead every week, all the boxes being kept full and covers down. During the year 52 million cubic feet of coal gas went through these boxes, the maximum being 240,000 feet per day. The result is uncertain, in that there were 15 changes during the year for pressure and repairs to covers and trays. Pressure changes were frequent, due to worn-out trays and poor scrubbing, correction of which was not effected until late in the year. Yet there is the remarkable fact to record that not once in the entire year did the second box in the series show foul. No air has been introduced into the coal gas.

These experiments were undertaken in an endeavor to ascertain, under favorable conditions or area, if any revivifying efficacy resided in the purified gas. To Mr. Byron Chollar, who has patented a reversible purifying box or series of boxes, in which the flow of gas can be reversed in the box, and who covers in his patent the reversal of the flow in the box, must be given the credit for the first scientific employment of the theory that the revivifying process does not go on efficiently in the presence of hydrogen sulphide. It was shown to us conclusively in our experiment, and repeatedly towards the end of the last change, that the oxygen was carried mainly over to the second box, doing the work there that it refused to do in the first. In the ordinary method of box handling it must be that the revivifying air is driven farther and farther from the point of first contact, always operating where least needed, and finally in part escaping with the purified gas; while, with the Chollar boxes, or any method that places the fouled box or layer beyond the reach of the sulphur impurity, the introduced oxygen is effectually and wholly employed. Conclusions based on these observations will be advanced later.

The claim is now made (the writer does not know how seriously) by the exploiters of the novel form of box above mentioned that "The purified gas revives the foul oxide," and this is the point immediately under investigation. Our reversal system, already explained, allowed revivification to proceed under the favorable condition required for best results, in that the hydrogen sulphide was removed in the first (pure) box. The results during the first year seemed fairly conclusive that there was some revivifying virtue in the purified gas. The boxes did come back to condition and do further work without the introduction of oxygen, and lasted many times as long as they would have without reversal. On the other hand there was a limit to this agency, and the use of oxygen added greatly to the efficiency. This in turn was only one-third the usual amount, and slightly less than the theoretical amount for water gas, yet by the method used the oxide purified over 50,000 cubic feet per bushel while practically new. It is the writer's belief that an efficiency of 100,000 cubic feet per bushel can be reached by careful application of observed results. If the purified gas revives the foul oxide, even in part, then:

1. Oxygen must be present in the unpurified gas; or
2. Oxygen must be evolved in the process of purification.

The writer is not prepared to discuss either of these propositions except to suggest that even a casual inspection of analyses of various illuminating and fuel gases shows oxygen generally present in small amounts, and that the admission of 1½ per cent. of air which has been considered about right for revivifying in the old way (and why the same rough amount for water gas as for coal gas?) means only $\frac{3}{10}$ per cent. of oxygen; and to ask the question, why, if the revivifying method is effieient, should there be any oxygen present in the purified gas?

It is regretted that analysis of the gas at Norfolk, purified and unpurified, cannot be given, but facilities have not been available.

We thus have an experiment in the purifying of water gas extending over 2 years, but which, while apparently successful so far, has from that very success afforded as yet only limited data. The coal gas experiment is merely related as interesting as no deduction can yet be made from it. In case of the water gas we may compile the facts as follows:

1. Large area and moderate depth.
2. Without air some revivification, failing, however, within low limits.
3. With ½ per cent. of air, revivification proceeded to high limits, giving,
4. 52,500 cubic feet purified per bushel per change.
5. 123,000 cubic feet purified per square foot area per change.
6. This result, with material practically new, having been only once revived in the open.
7. Cost of purifying labor 1903, $\frac{3}{10}$ cents per 1,000 with no labor saving machinery.
8. Oxide in last change hard and dry. No pressure, but picks necessary to remove it.
9. The revivification took place in the second box, acting feebly or not at all in the first, where the oxide was fouling from the hydrogen sulphide.
10. Slight trace of sulphur in the gas, each reversal sometimes showing in the mixed street gas for a short time, but only for a short time, and never appreciable.

And hazard the following conclusions:

1. Revivification in situ should for efficiency be conducted in the presence of the purified gas only.
2. Unless positively proved objection as to the candle power advantages lost, the logical point of introduction of the oxygen is after the first box in such quantity as will revive that box by the time the active box shall have fouled.
3. The amount of oxygen required is not more than the theoretical amount and may be somewhat less, and is, therefore, less than has heretofore been thought necessary.
4. Objection (if made) on the score of decreased candle power from the use of revivifying air is thus minimized.
5. Three boxes would be better than two, especially under more variable conditions, and when emptying and filling. No advantage beyond three.
6. The material can be used without "regeneration" to a point where regeneration would not be effective.
7. Great depth is not important, but area is. If area is sufficient (say in accordance with the ½-inch travel per second rule) fouling of the oxide proceeds slowly from the bottom to the top. Meanwhile the previously fouled box is being equally revived, and with sufficient reversals only moderate depth is essential. Increase in depth is but the same in effect as increase in the number of boxes in series, and neither is economical.
8. Investment of capital in elevating machinery is of doubtful advantage, and in regenerative air blowing equipment not of any.
9. Further experiments along these lines should be made with both coal and water gas, followed by analyses of the course and action of the oxygen (both that in the gas and that artificially added) under different conditions. Also a study as to the rapidity with which the fouled box can be revived by temporarily increasing the percentage of oxygen in emergency.

The writer is aware of the brevity of his facts and the wide range of his conclusions. The experiment at Norfolk is but begun, and it is at the request of your President that the statement of its progress thus far, and some attempt to form a working theory, are made, in the hope that investigation may be stimulated elsewhere.

Discussion.

The President—This is a very important subject and I hope it will be fully discussed.

Mr. Doherty—Mr. President, I would like to suggest that Mr. Harrop be called upon to open the discussion on this subject.

Mr. Harrop—Mr. President, I just said to Mr. Butterworth that I did not know anything about it and he suggested that I get up and say so. I really feel that I ought not to say anything on this subject, particularly at this time. I have done a great deal of work on oxide purification, with reference to fixed sulphur compounds, and I expect within the course of the next year or so to do a great deal of work on hydrogen sulphide in our new gas works on the west side. Some of the suggestions made in this paper will undoubtedly be of great value. A great many points made by Mr. Rice in his contribution are extremely valuable, but other statements made by him seem to me not quite in accord with the results that I have seen attained. Yet I feel that I have not pushed my experimental work far enough to make any further statements on the subject at this time. In reference to the Chollar spstem, I may say it is a very interesting and important feature of this work. The idea which that system is based on, that the oxygen in the unpurified gas, that is the oxygen in the presence of hydrogen sulphide, does not revivify the oxide, is perhaps the most important point in oxide purification, and whether that is so or not will govern largely the results that may be had from handling oxide by this means. I do not think I care to say anything more on the subject at the present time.

The President—We will expect to have Mr. Harrop write us a paper then about a year from now on this subjeet.

Mr. Osbourne—Mr. President, it seems strange to me that some of the larger works do not give us a little information on this subject. It is

also strange that anyone writing to the Secretary of an Association of this kind, or to other people interested in such an important subject, is not able to draw forth information or suggestions which would be of much assistance to members who are connected with the smaller gas works, because in the laboratories of the larger ones, they have opportunities of research and must have data which will be very valuable to those interested in the subject. But for some cause or another I have been unable to have any reason assigned, which seems satisfactory at least to me, why they fail to give us the information. I would like to ask the Secretary, who, I feel certain, has endeavored to draw these people out, what success if any he has had in securing data on this subject. I know that a request was sent out by Mr. Doherty, asking for the names of people who would say something on topics of interest, and I remember having written to two or three persons personally requesting them to give us data which would be valuable and which they could give if they would, but which they refuse or at least neglect to furnish. I am at present not able to furnish any data; but if I had kept the data that at one time was in my possession, it probably would be very well received by those desiring information. I think, however, I will be able to give something on this subject in a year or two which may be of some value. I was unable to secure the data I desired at the time I was looking for it. I wish something could be done to stir up some of the good people and arouse additional interest on this subject. In the smaller works it seems to me that the question of purification is of rather minor importance. Take a works that has an output of 12 or 15 millions annually; with a common, ordinary purifying box and with Connelly sponge, the cost of purification does not amount to $100 per year, and is even less than that in my experience. In the smaller works there are other things that are of more importance, but undoubtedly in the larger works it is a very important subject. The new purifying arrangement that has been spoken of in this paper, it seems to me, ought to stir up a renewed interest and result in important developments along this line.

Mr. Greenough—As a representative, Mr. President, of one of the larger works, I should be very sorry to have the impression prevail in this community that there are any figures regarding oxide purification which are not entirely at the service of the gentleman who has just taken his seat or any other member of this Association. I do not think that experiments on purification are going on to any great extent in most of the large works. I agree with the gentleman who has just taken his seat that the cost of purification in the smaller gas works is so small as not to justify the expenditure of much time or money in experimentation. In the larger works, however, it, of course, is a much more important feature of the business. Speaking with reference to the works with which I am connected, we have invested considerable money in experimenting in the regeneration of material in situ. The material has decreased the cost of purification in our works. There is very little to be said in regard to purification. The cost of it is so small per cubic foot of gas that we are now making hardly any experiments at all. Occasionally we make a test to ascertain how much sulphur there is in it. I object emphatically, as a representative of one of the larger works in Ohio, to the suggestion that we have any figures on the subject of purification which we are keeping back. We have no such figures. We have figures on other subjects which may be of interest to the gentleman, but certainly not on purification.

Mr. Butterworth—I agree with Mr. Greenough, and I presume we all do, that the operating cost in the matter of purification is a very small item of expense. It is not a matter of cost that makes it important, but the important matter is to have your gas free from hydrogen sulphide. I recently obtained data from a number of large and some small companies in relation to the operating cost of purification as compared with the investment cost, and I found as the result of the inquiry that if we could dispense with the purifying houses themselves, which some of the companies are doing, and put our boxes outdoors we would save in interest on first cost, taxes, insurance and depreciation of buildings a sum equal to two-thirds the operating cost of purification. So that the best way for us to economize in the matter of purification, that I know of, is to dispense with the purifying house itself.

The President—That is a good suggestion; very interesting and very important. We know it has been done successfully. We had a paper at our last meeting which gave us a good idea of the mode of construction of such an equipment. It is a curious fact, however, that while we realized the truth of all that has been said about purification, nevertheless there are probably as many, if not more questions or inquiries about purification in its different branches than most any other subject connected with the manufacture of gas, and we are apt to think that the small gas company has little trouble. But they appear to have more trouble with purification and to want more knowledge about it than the larger companies.

Mr. Schwarm—I think it is a subject that interests the public more than the gas fraternity. Gas that is not absolutely pure will cause more kicks and complaints than all the low candle power gas that we could fnrnish. It is a question that has a very wide scope. Your statement in regard to the number of questions that are asked by the smaller companies is undoubtedly true, as will be illustrated by going over Mr. Doherty's question list. To the larger companies, as Mr. Greenough and Mr. Butterworth said, it is largely a matter of capital investment, but to the smaller companies it is an important question, not so much from the actual cost involved as it is the question of furnishing gas that is absolutely pure, and I think the object of the writer of the paper was more on these lines to show that in the ordinary sized gas works an effort should be made to get the cost of purification down to the lowest limit and also to furnish gas that was practically free and clean and pure.

The President—We would like to hear from Mr. Hayward on this subject.

Mr. Hayward—Mr. President, I labor under a little embarassment always in discussing a subject of this kind; first, for fear that there may be an impression created that I have an axe to grind in the way of advertisiing. As you are all aware, I am an ambassador of commerce. I am engaged not in selling kindling wood but in selling sponge. The other embarassment under which I labor in attempting to discuss this subject at this time is that I have not read this paper and I knew nothing whatever about it until it was read here a few moments ago. I would like to have spoken on several points. There is a good deal of interest in the matter of purification, more than perhaps we realize, because the men who want the most information are the men who are not here. The men who attend these Associations are the men who are pretty well posted. But it is the poor fellows who stay at home that want the information and they do not come here to get it. Another feature in regard to this is, while I am making oxide and selling it, I am not in the practical business of using it. Consequently whatever suggestions I may offer must come from me second-handed. It is just what I pick up in going around and talking with you gas men and learning from you the bumps that you encounter. Therefore, as I say, my information is second-handed. Mr. Rice has thrown out two or three suggestions that I want to impress upon you in regard to the handling of oxide. One of them is with reference to the condensers and scrubbers. You cannot secure efficient purification by using your purifying boxes as condensers or scrubbers. You must have efficiency before you reach your boxes. They must be larger. They must have capacity enough. The suggestion he makes of using the shaving scrubber before the box is a very valuable one, and I commend it to your judgment and to your use; because that does take up the oily vapors that are carried forward. If you allow them to accumulate in the purifying boxes you destroy your oxide. It is ruined, not because it has absorbed the sulphur, but because it has become oily, and in that condition it is never in any condition to reoxidize or revivify, as most of you know. So that is a very valuable suggestion. During the past year I have been advocating the use of the introduction of oxygen by means of a little blower which is attached to the exhauster. It is a very simple device; it costs but very little money and it saves considerable in the way of labor. Now when you can get the cost of labor for purification down to about $\frac{1}{4}$ of a mill, that is pretty cheap. As Mr. Rice says, in his works at Norfolk he was able to secure that result. But aside from the cost, there is a lot of nuisance in changing your boxes and looking after them, and the saving of that annoyance and trouble is worth a good deal. Now Mr. Rice has got that down to the point where he only changed his boxes once during the year 1903. That is a pretty fine point it seems to me and it is well worth your consideration.

Mr. Stone—I think Mr. Greenough has stated the exact fact in what he has said as to the difference in the request for information as between the manager of a small gas works and of a larger one. In the case of a small works oftentimes the works are constructed entirely too small in the first place. The consumption has increased and the works have been enlarged, and it is found that the scrubbing and condensing capacity is not what it ought to be, and possibly his purifying capacity is not what it ought to be, and he wonders why it is. He wonders why it is that he has to change his boxes about once a week and the manager of some other company only has to change his boxes once in six months, or once a year as stated by Mr. Rice. In running a small gas works, and especially a coal gas plant, the stokers do not like to do this work, and the manager does not like to keep a man around the works

just on purpose to do it. It is dirty and disagreeable work and they may have a little trouble in getting men to do it regularly. Not only that, but the matter of looking after it is somewhat of a burden. If you have to change your boxes and look after them very often it is a matter of considerable annoyance if you have to watch them closely. It is one of the points connected with a gas works where you have to watch the work all the time, and it is these things that bother you which you are called upon to watch continually. That is the reason the manager of a small gas works experiences more trouble on this subject than the manager of a large one. It occurred to me that Mr. Greenough struck the point exactly when he brought these facts out. If the manager of the smaller works had the same facilities as the manager of the larger works he would not be bothered so much. If his boxes and scrubbers were large enough and the condensers numerous enough, and he had the right kind of oxide, he would not need to change any oftener than the manager of the larger works.

The President—Any further comments, or any questions to be asked?

Mr. Harrop—I might volunteer one statement in addition to what I said a few moments ago. This paper makes a point as to the action of oxygen on the foul oxide, in the presence of hydrogen sulphide and out of the presence of hydrogen sulphide. I said, I was not able to state definitely about that but there is one thing I can say. I had a paper at the last year's Detroit meeting of the McMillin Managers' Association, covering a rather exhaustive set of experiments which I made on the oxide purification in our Third Ward works, with its bearing on carbon bi-sulphide, and I have shown conclusively that some carbon bi-sulphide is stopped in the boxes in a very small measure, even when the material is absolutely new. Now, the hypothesis we work on is the physical absorption of the carbon bi-sulphide by free sulphur, and the indications are that the iron is sulphided by the hydrogen sulphide, the oxygen in the gas oxidizes the iron sulphide and frees the sulphur and this free sulphur absorbs a small quantity of the carbon bi-sulphide. Supposing we have three boxes in line, and if the gas is thoroughly purified in No. 1 and No. 2, and supposing there is free sulphur in No. 3 box, then it is easy to see how carbon bi-sulphide is absorbed by the sulphur in No. 3 box, without interfering with the contention made in the paper under discussion. But if the first box is new material, and it is found that less carbon bi-sulphide is in the gas at the outlet of that box than at the inlet of that box, and there has been absorption of carbon bi-sulphide in that box of new material, it would seem to indicate that the iron sulphide formed in that box from the hydrogen sulphide has been revivified presumably by the oxygen in the gas and also presumably in the presence of the hydrogen sulphide. I state that as a fact. The quantity absorbed is exceedingly minute, but it is absorbed and there seems to be no way of getting around the fact, or the apparent fact, that the iron sulphide is oxidized in the presence of the hydrogen sulphide. In reference to what His Excellency, "the Ambassador," said of the importance of scrubbing and condensing the gas before it reaches the purifiers, Fred. Bredel told me this morning that he was working on 7 per cent. sulphur coal out in Kansas, and had 14 scrubbers and washers, with a small purifying system which was not worked to its full capacity. It would look as though that washing was pretty thorough. If Mr. Bredel is in the room I would like to hear from him on that subject.

The President—Mr. Bredel, your name has just been mentioned in connection with the purification of gas from 7 per cent. sulphur coal with 14 scrubbers and washers and a small purifying equipment. We are discussing the question of economy in oxide purification and we would be very glad to hear from you on it.

Mr. Bredel—It is a question of purifying Kansas coal. I want to say I had an experience once with gas from Illinois coal and it was claimed that it could not be purified by oxide of iron. The only question is, how often you want to wash your gas. If you do not mind 20 inches or so of back pressure you can do it. The absorption of carbon bi-sulphide is to a small per cent. a chemical action, but I think that the real action is a mechanical action. Bi-sulphide of carbon being condensed out of the gas, the point of liquefaction of the bi-sulphide of carbon is higher than the ordinary temperature under which the gas is sent through the apparatus. Now, if you wash long enough, the bi-sulphide of carbon is dropped. If you wash with fresh water the illuminants are also dropped. If you wash with saturated ammoniacal liquor, there is no danger of absorbing the illuminants. Then they do not drop but the sulphur drops. If you use only one or two or three washers—"No." The washing has to be done at a temperature above 80. Some of the coal we have used down there has analyzed 11.6 per cent. sulphur, and the average is between 6 and 7 per cent.

The President—That is very interesting information.

Mr. Stone—Before we leave the subject, there is one point I would like to get clear in my mind. Do I understand this system as advocated by Mr. Rice does not in any way conflict with the patent that has been granted Mr. Chollar for the purification of gas by means of a reversal of the flow? This system that is advocated by Mr. Rice is with reference to the purification of the gas by passing it in the same direction, as I understand it, and Mr. Chollar's system is based on the purification of the gas by passing it in a reverse direction to that in which it was passed before. The question in my mind is whether or not there is any conflict between the two methods?

The President—I feel quite sure that Mr. Rice would not use or advocate the use of anything which he thought conflicted with any established right.

Mr. Schwarm—I think the purification proposition is an interesting one to all, and one of the hardest to deal with from a manager's standpoint. I would like to hear from Mr. Lynn, who I understand uses Kansas coal at Joplin, how they purify their gas. I understand it has quite a good deal of sulphur.

Mr. Lynn—We are purifying entirely with lime. We cannot use oxide with the Kansas coal. Mr. Young, who is here, has had practical experience on this subject. I have had no practical experience at Joplin. We tried oxide but had to abandon it. We did not, of course, have 14 washers or scrubbers or anything of that kind, but we had the ordinary condensing apparatus and a hot scrubber besides, but we could not purify at all with oxide; we had to use lime.

Mr. Bredel—I may say we used iron purification and not lime.

On motion, a vote of thanks was tendered to Mr. Rice for his valuable, interesting and instructive paper.

On motion, a recess until 2 P.M. was ordered.

(To be Continued.)

Advantages of Cooking and Heating by Gas.

Last month Mr. T. G. Marsh, of Manchester, England, read a paper before the Society of Architects, on "Domestic Fires and Their Relation to the Smoke Nuisance," for an abstract of which we are indebted to the *Journal of Gas Lighting:*

In the earlier part of his communication the author pointed out that the domestic coal grate remained the greatest sinner against pure air, and that it was only to municipal authorities, architects and engineers that it was possible to look for those efforts which would eventually rid our towns and cities of the smoke nuisance. They were, however, on the eve of an inevitable revolution in methods of obtaining power and heat, and the signs had spread further than many people thought. Fuel in the future would be delivered in gaseous form. This was the only solution of a great scientific problem—the conversion of the latent energy stored in coal into an amount of useful work more nearly approaching the mechanical equivalent than was now secured. With a modern steam engine, they practically obtained only one-tenth of the stored energy contained in the fuel; while with a gas engine they secured about one-fourth. In 1883, there were only 5,000 gas engines (mostly of small power) being used in Great Britain; whereas to-day there were 90,000 of various sizes. Taking these facts into account, and recognizing moreover that Mond and other power gases were coming largely into use, they might confidently look forward to a time when smoke from engines and furnaces would be a thing of the past.

In the case of gas cookers and fires, Mr. Marsh remarked, the amount of smoke sent out had not decreased to the same extent as with other fuel consumers. He then continued as follows: "We find that there are 1,330,000 gas cookers in use in the United Kingdom; and these, more especially during the summer months, have considerably decreased the coal bill. Upon this particular subject, I would call your attention to a matter which has probably escaped your notice, but which is well worthy of consideration. Gas cooking stoves are almost invariably fixed in houses without any connection to the chimney; and there are no means of freeing the house frem the odor of the cooking viands. I have frequently had occasion to complain of the smell arising from these. In very few instances have I found the odor to be due to the products of combustion, but generally to be the result of the burning of grease that has been allowed to accumulate on the stove. A simple arrangement for the carrying off of these odors to the chimney breast or other suitable position would, I am sure, be considered as a great boon; and seeing that one-fifth of the whole of the gas consumers of this country are now users of gas cooking stoves, I think the matter well worth attention. As regards the heating of our houses, we have in this country almost exclusively the old-fashioned, open fire grates—cheerful in appearance, and wasting a large

percentage of the fuel. Various attempts have been made to improve these fires; but they have almost without exception been failures.

I am of opinion that the principal reason why gaseous fuel has not been adopted more generally for heating purposes is that the price has been considered prohibitive—in many cases the various savings attendant upon its adoption not having been fully taken into account. I believe that gas should be sold at a very considerable reduction in price for purposes other than lighting. It may be taken that a gas cooking stove using gas at 3s. per 1,000 cubic feet, and a kitchen range with coal at 16s. per ton, are about on a par as to cost. It is, however, very different with gas fires. With these, the price of gas should be fully 20 per cent. less than in the case of cookers; otherwise the cost is much too high to allow of their general adoption.

The sale of gas for the purpose of heat and power was never cultivated, but was rather held back, by the majority of our gas authorities until competition began to face them in the shape of the electric light. The wedding together of the two businesses—"lighting" and "heating and power"—was simply a "marriage of convenience;" and though some gas authorities claim that the price of gas should be the same to all consumers, I am not at one with them in this contention, and consider that, like all marriages of convenience, this one (light and fuel) will come to an end unless more favor is shown to the fuel. Though the gas sold in each case is exactly similar, the cost of that which is sold for heat and power is certainly considerably less than that which is used for lighting. The capital expenditure required for supplying lighting gas is about 5 times that required for the supply of gas for heat and power. In the one case, the greater portion of the annual sale is during 4 months of the year, and only then during a few hours per day; whereas if the gas is sold for other purposes, it may be said to be equally distributed over the whole year, and is burned on an average 9 hours per day (Sundays excepted).

Recently, Alderman Gibson, the Chairman of the Manchester Corporation Gas Committee, said: "We are taking many hundreds a year out of the hands of the poor gas consumers, and putting it into the pockets of large ratepayers who are rich, and do not use gas at all. It is a monstrous robbery; but no one takes up that phase of the question at all. This claptrap phrase of relieving the ratepayers, is a popular term; but it is utterly at variance with the truth, and utterly fallacious." This is the opinion of a Chairman of a Gas Committee who has had almost a lifetime's experience. By municipal authorities the subject should be looked at also from another point of view. The success of a town is largely dependent upon the health of the people, and upon their comfort and happiness. It is therefore the duty of municipalities who are owners of gas works to so reduce the price of gas for heating and power purposes as to make it within the reach of every householder to adopt it.

The allowing of a discount when sold for these purposes appears in the past to have been the great difficulty, inasmuch as it would entail considerable capitalization upon the gas authorities; a duplicate set of pipes and a duplicate meter being necessary for each house. This difficulty, however, I am pleased to say need now no longer be taken into account, as fortunately there are means for registering the quantity of gas used without having recourse to the cumbrous wet and dry gas meters. The new registering device is not larger than an ordinary breakfast cup, and can be fitted alongside the stove without in any way being obtrusive—in fact, it becomes practically a part of the stove. Where adopted, the whole of the supply for the premises will pass through the master meter and the usual pipes; and the registration for account purposes will be taken from this meter. For making a rebate on the amount of gas consumed by the stove, the registration of what we may term the discount meter will be taken, and a certain amount will be allowed upon each 1,000 cubic feet that has passed through it.

When the public have been fully educated, and are alive to the advantages of gaseous fuel, we may look forward with confidence to the return of our atmosphere to the state of purity existing prior to the days when solid fuel began to be so recklessly burnt; and I have little hesitation in saying that greater profits will accrue from the utilization of the products of combustion than from any policy, fiscal or otherwise, that the country may adopt.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

Electrolysis and a Cure Therefor.

OFFICES OF GRAY & NEILL,
BRADFORD, PA., April 2, 1904.

To the Editors AMERICAN GAS LIGHT JOURNAL: A satisfactory means preventing the destruction of piping systems by electrolysis has been sought by gas and water companies for a number of years, and numerous schemes have been tried without avail, until it has become almost the universally accepted idea that absolute prevention of electrolytic action, where single trolley street railway systems were in operation, is impossible. The writer has been actively engaged for a number of years in dealing with the electrolysis problem, and can state positively that electrolytic action can be entirely prevented on any piping system, distributing either water or gas, and regardless of the conditions which may exist. If such good results are desired, however, the old plan of in any way connecting the piping system to either the rails or the bus bar of the dynamo must be discontinued and the matter dealt with in an entirely different manner.

The extent of electrolytic action under any given conditions is proportional to the amount of current flow, and to that alone. The connecting of a piping system to the railway system increases the amount of current flow on the piping system from 25 per cent. to 100 per cent., depending on how perfectly the bonding of the two systems is done. This being the case, it requires the exercise of only an ordinary amount of reason to see that, in making such connections between the two systems, we have *increased* the cause (*i. e.*, current flow) of electrolytic action, and that such increase in the cause cannot but increase the effect.

If gas companies would take more pains to make their piping systems poor conductors of electricity and bend their energies, *not* in trying to take current from their mains in the vicinity of the power station without suffering damage, but in preventing such currents from entering and flowing over their mains at all, they would have much less damage from electrolysis.

It is not only possible, but extremely practicable, to so break up the metallic continuity of a piping system as to entirely prevent current from flowing thereon, and the writer can mention several very large plants where this plan has been used with perfect results.

In this connection the writer would quote the following from an article written by an eminent consulting electrical engineer and one who is an authority on the subject of electrolysis: "The plan used to a great extent is the connection of the pipes to the negative side of the feeders, thus affording an easier path for the current than is afforded by the ground. If the pipes were without joints this would be an excellent plan. Like joints in the rails, however, the pipe joints offer a considerable resistance, which in most cases is sufficient to cause the current to leave the pipe for the ground, to return again after passing the joint, and as the amount of current that flows over the pipe is greater than it would be if such connections were not made, the result is that corrosion takes place very rapidly at such joints.

"A better plan would be to break the continuity of the metal in the pipes by the insertion of insulating joints at suitable points, thus preventing any flow of current over the pipes. This plan of placing insulators or circuit breakers was not adopted at first because none had been devised. Quite recently such insulators have been used.

"I have recently taken measurements on the natural gas pipes in Wheeling, W. Va., to ascertain the flow of current from pipes to rails, and also the flow of current on the different lines of pipe. I will not give here a list of these measurements, but as a result of one made near the power house I found 300 amperes flowing from pipe to rail, the pressure being 10 volts, representing about 4-horse power. The gas company decided to place insulating joints in its pipe system. I have just returned from Wheeling where the work has progressed far enough to show that the lines wherein these joints have been placed have little or no current flowing over them, and when work is completed their pipes will not act as return feeders for the railway, and electrolytic corrosion will cease. It will be a matter of indifference to the owners of these pipes what condition the street railway tracks may be in."

I also quote from another report, as follows: "The method heretofore adopted of draining the piping system of current, by connecting it to the negative side of the dynamos, is *not* the correct one, for then the pipes become return feeders for poorly bonded and undersized tracks, and rapid electrolytic corrosion takes place at the joints, due to the resistance offered by them to the passage of the current. When, however, lines are cut up into sections by insulating joints, current will not flow to, over, or from them and they will not suffer from electrolytic corrosion."

As the above bears out the experience of the writer in every case where this method has been adopted, I trust this communication may be of some benefit to your readers. Yours truly, A. ROSS GRAY.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

IT is said that the Northwestern Gas and Electric Company has arranged for the construction of a power plant, which will cost well in excess of $200,000, on its works in Walla Walla, Wash.

THE Public Service Corporation, of New Jersey, has arranged for an extension of its gas mains from Montclair to and through the boroughs of Caldwell, Verona and Essex Falls.

WE have received from the Detroit Stove Works copies of its newly issued 8-sheet gas range poster, and of its booklet, the title of which is "Cooking with Gas." Gas companies should have both, for there is much good in them.

MESSRS. LINDSAY & Co., of Chicago, inform us that, owing to the great increase in their business, they bave secured commodious headquarters and factory accommodations in the premises Nos. 195 and 197 Michigan street. They say that under the new manufacturing conditions they will be easily able to turn out 25,000 incandescent gas mantles per pay.

A CORRESPONDENT in Denver, Col., writing under date of the 2d inst., says: "The Boulder (Col.) Gas Company has been purchased by a local syndicate, who have reorganized the concern under the title of the Federal Gas Company. Those mainly concerned in the deal are largely interested in the Boulder Electric Light Company. Peter English, the President, and Frank English, the Secretary of the Boulder Gas Company, retired from the directory, and A. J. Mackay, H. Cassaday, A. A. Reed, E. A. Austin and T. B. Whitted now compose the Board of Directors. Mr. Whitted, who is the Manager of the Boulder Electric Light and Power Company, will become Manager of the Federal Gas Company. The office fixtures and furniture of the Gas Company have been removed to the office of the Boulder Electric Light and Power Company. It is stated that the officers and directors of the Federal Gas Company, incorporation papers for which are now being drawn, will be A. J. Mackay, President; H. Cassaday, Vice-President; A. A. Reed, Secretary; Joseph Bergheim, Treasurer; T. B. Whitted, General Manager. It was announced by Manager Whitted that $15,000 will be expended in the near future in extending the gas mains."

ADVICES by way of Marquette, Mich., are to the effect that the Hancock (Mich.) Common Circuit has granted a franchise to the promoters of the Portage Lake Gas and Coke Company permitting them to construct and operate a gas works within the limits of Hancock. The life of the franchise is set for 30 years. Detroit and Chicago capitalists are back of the project which is represented locally by Herbert Baer, of Hancock. The Houghton Council also has been asked for a franchise, the intention of the Company being to serve the two towns, and there is little doubt that favorable action will be taken.

MR. FRED. J. LUCEY, for several years Managing Director of the Natick (Mass.) Gas and Electric Company, has gone into the field of gas and electric engineering, as a specialist, on his own account. His headquarters are in the Ames Building, No. 39A, Boston, Mass.

MR. VAUGHN W. DUKE, whose resignation as Superintendent of the Nassau County (L. I.) Gas Company was recently reported, has been appointed to a department superintendency in the Consolidated Gas Company, of New York.

MR. CHARLES F. GITTENS has resigned from the directorate of the Nassau County (L. I.) Gas Company, and also from the Secretaryship of the Hempstead (L. I.) Gas Light Company. It is quite on the cards that the supplying of gas on Long Island, in the counties of Queens, Nassau and Suffolk, will be of much importance and magnitude within the balance of the current decade.

MR. GEORGE M. LAWRENCE has been appointed Receiver of the properties of the Canon City (Col.) Gas Company. He is largely interested in the property, and the receivership does not mean that the enterprise is to be abandoned. Quite the contrary, it likely indicates that the Company's affairs will be put in shape to properly work the field that it sought to suppiy.

MR. MALCOLM S. GREENOUGH, President of the Cleveland (O.) Gas Light and Coke Company, has been appointed by Governor Herrick a member of the Board of Trustees of the Ohio Archaeological and Historical Society.

MR. S. H. HESS has been appointed Manager of the Traverse City (Mich.) Gas Company.

MR. C. F. CATTELL, Superintendent of the Gas Company, of West Chester, Pa., has made final arrangements for the betterments on that plant. These include the virtual reconstruction and equipment of the purifying system.

THE voters of Danbury, Conn., have decided adversely on the proposition that the city acquire the plants of the Danbury and Bethel Gas and Electric Company for operation on municipal account.

MR. W. H. P. HILL has been appointed Manager of the Salinas (Cal.) Light and Power Company. He assumed charge the 1st inst.

MR. JOHN BECKFORD HILL, one of the organizers of the Beverly (Mass.) Gas Company, and for many years its Treasurer, died at his home in Beverly the morning of March 28th. Deceased was born in Beverly, July 16th, 1824, and from his early youth was prominent in the business, political, Masonic and social circles of his native district. He represented Beverly in the State Legislature for three terms—1854, 1874 and 1876. His wife and three children survive him.

CAPTAIN J. H. KAUKE, one of the organizers of the Wooster (O.) Gas Company, and its President at the time of his death, died at his home in Wooster, the morning of Sunday, March 20th. Deceased was in his 87th year, having been born in Wooster township, O., December 15th, 1817. Despite his advanced years, his vigor and health would seem pretty well illustrated through the remark that he attended the last session of the Ohio Gas Light Association, held in Cleveland the week before his death. No silver spoon was his in his babyhood, nor was indolence the portion of his youth, but rugged health, a sharp intellect, honesty of purpose and well pursued methods brought him wealth, the respect of his fellow townsmen and the affection of his intimates. Although much more largely concerned in other business enterprises in Ohio, his particular pet was the Wooster Gas Light Company, and his rugged personality was one well and favorably known to the fraternity of the State. He was an active member of the Ohio Gas Light Association, and seldom missed one of its meetings. He was a member of the Board of Trustees of the University of Wooster, which institution he helped to found in 1866.

THE Western Gas Construction Company, of Fort Wayne, Ind., has been awarded a contract, for the placing of a 6-foot 6-inch water gas apparatus of the latest approved style of construction, on the plant of the Stamford (Conn.) Gas and Electric Company.

THE Providence (R. I.) Legislature has vetoed the application of the Providence Gas Company to increase its capital stock from $3,250,000 to $4,000,000.

THE Supreme Court of New York has granted Mr. Edward C. Atwater, Receiver of the Consolidated Gas and Electric Company, of Batavia, N. Y., permission to shut down the gas plant on the ground that the plant is being run at a loss.

ADVICES by way of Hartford, Conn., dated April 1st, are to the effect that the New London (Conn.) Gas and Electric Company, has reduced the price of gas from $1.75 to $1.50 per 1,000 feet. There is also to be a change in the discounts. The discounts on illuminating gas run from 5 cents to 25 cents per 1,000 feet, according to the quantity used, making the net price from $1.45 to small consumers to $1.25 to the large consumers. The price for fuel gas remains the same, but the discounts are larger, being from 14 to 35 cents per 1,000 feet, making the net price to the large consumers $1.05. The price of electric light also remains the same—15 cents per kilowatt, but for this also the discounts are larger, making the price to the small user 14½ cents and to the large users 11½ cents net. The new rates took effect the 1st inst

ON complaint of the Mayor and Common Council of Dover, Vice-Chancellor Pitney has made an order requiring the Dover, Port Oram and Rockaway Gas Company, to show cause why a receiver should not be appointed. It is claimed that the Company is insolvent, but no schedule of assets or liabilities is given.

AT the annual meeting of the American Gas Company, of Philadelphia, the Directors elected were: M. W. Stroud, Lewis A. Riley, J. C. Lowry, Edward B. Smith, J. S. Jenks, H. C. Jones, E. H. McCullough, Philadelphia; William Carpender, Edmund Penfold, W. R. Beal, New York; C. J. Carpender, New Brunswick. The Company reports a very successful year.

AT the spring municipal election in Iowa Falls, Ia., the proposition to grant a 25-year franchise for the operation in that city of a crude oil gas plant, on the petition of W. H. Woods and W. H. Harrison, of Chicago, was assented to.

MT. PLEASANT, Ia., has also voted in fávor of establishing a gas plant.

MR. PHILO JONES, for several years in charge of the Monterey County (Cal.) Gas and Electric Company has accepted a responsible position with the California Light and Fuel Company, of San Francisco. It is understood that his first active service in connection with the concern will be the direction of the plant at Watsonville, Cal.

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NOTIFICATION RESPECTING ADVERTISING.
Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:
New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, APRIL 11, 1904.

The Market for Gas Securities.

Returning reason, respecting the stability of the gas business of New York city, seems to have visited the Broad street temple wherein gentile and Hebrew frequently contest for financial supremacy. The "gas grab" looks to have an excellent chance to come down to Mr. Murphy's man—Mayor McClellan—for approval or disapproval, and as both are in favor of doing the greatest good for the public of the city, the chances are all in favor of the Mayor assenting to a measure that in 5 years' time will put the gas works where they properly belong; that is, on the east bank of the East river. Consolidated closed to-day at 201½ to 202.

Brooklyn Union moved up sharply to 201 bid, holders asking 205. Keep your eyes on this security, for another $5,000,000 issue of convertibles would readily be absorbed by those who control its fortunes. Baltimore Consolidated is strong, at 72½ to 72¾. Peoples, of Chicago, looks very tempting at 96½, and the "peggers" say (but don't swear) that Laclede common is 90 bid.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

APRIL 11.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	201½	202
Central Union, Bonds, 5's	3,000,000	1,000	104	106
Equitable Bonds, 5's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan	668,000	..	108	112
Mutual	3,500,000	100	200	290
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. ..				
Bonds, 5's	11,000,000	1,000	105½	106
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	31	..
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	..	..	..
Northern Union, Bonds, 5's	1,250,000	1,000	102⅛	105⅛
New York and East River ..				
Bonds 1st 5's	3,500,000	1,000	109⅛	111
" 1st Con. 5's	1,500,000	..	106	108
Standard	5,000,000	100	125	13
Preferred	5,000,000	100	145	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	117
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	201	205
" " Bonds (5's)	15 000,000	1,000	113	115
Bay State	50,000,000	50	3/16	¼
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	3¾	4
" " Bonds, 5's	5,250,000	1,000	65	69
Capital, Sacramento	500,000	50	..	55
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas and Electric Co	29,500,000	100	96⅜	96⅝
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101⅛
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¼	89⅛
Preferred	3,026,500	100	107½	109
Consumers, Jersey City Bonds	600,000	1,000	100	102
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	..	72¾
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	86	90
Consolidated G. & E. Co.'s.				
Little Falls, N. Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,825,500	50	..	50
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	351,000	1,000	75	75¼
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	15	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	58	59
" Bonds, 5's	10,500,000	..	103	104½
Indianapolis	2,000,000	..	55	65
" Bonds, 6's	2,650,000	..	103½	103½
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	90	100
Preferred	2,500,000	100	90	100
Bonds	10,000,000	1,000	109½	110
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	136	140
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	107½	108¼
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	184¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	1,000,000	25	64	70
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	96½	96¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	.
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	15,800,000	100	..	55
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	92	96½
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	113½	115
General Mortgage, 5's	2,465,000	1,000	92	93
Syracuse, N. Y.	1,975,000	100	46	48
Bonds	2,047.000	1,000	94	96
Washington, D. C	2,600,000	20	288¾	290
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	..	..	..
Wilmington, Del.	600.000	50	230	..

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., N. W. CORNER BROAD AND ARCH STS., PHILADELPHIA, PA., March 9, 1904.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable April 15th, 1904, to stockholders of record at the close of business, March 31, 1904. Checks will be mailed.

1502-4 LEWIS LILLIE, Treasurer.

Wanted, Position
AS SUPERINTENDENT,

By a first-class gas engineer and superintendent. Understands the manufacture of coal and water gas; also, the laying of high and low pressure mains, in detail. Is a first-class hustler for new business. Can furnish required reference. Address, "UP-TO-DATE,"

1505-4 Care this Journal.

Wanted, Position
AS MANAGER

Of gas, or gas and electric light plant, by a man who can show first-class results in former positions. South or Southwest preferred.

1494-tf Address, "T. W.," care this Journal.

WANTED,
Position as Manager Or Superintendent,

By a young man of 34. Have had 7 years' experience in the gas business, 4 years as manager, in a town of 40,000. Have handled both coal and water gas. Best of references furnished. Address, "A. W. B.,"

1504-3 Care this Journal.

Situation Wanted.
EXPERIENCED MANAGER.

Thoroughly familiar with every department of the business. Coal or water gas. Successful in economical operation and development of new business. Can guarantee results. Young man. Excellent references.

1500-tf Address, "DIVIDENDS," care this Journal.

WANTED,

A YOUNG MAN, having some knowledge of manufacture of coal gas, laying mains and services, house piping, etc., to take charge of such work in a Southern city of 12,000.

1505-1 Address, "S. J. L," care this Journal.

WANTED,
Second-Hand, Steel Tank Holder.

Fifty to 75,000 cubic feet capacity. Address,

WEST SIDE GAS COMPANY,

1505-1 KINGSTON, PA.

WILL BUY
A Good Gas, or Combined Gas and Electric Plant.

Not particular as to location if it is a good proposition. Address, "PURCHASER,"

1505-1 Care this Journal.

FOR SALE AT A BARGAIN.
A 50,000-foot, Wrought Iron Gasholder, in Brick Tank,

With lattice iron guide framing, in first-class condition. Blue prints on application. Address,

THE MARIETTA CONSOLIDATED GAS CO.,

1505-2 Marietta, O.

FOR SALE.
New 140,000 Cubic Foot, 2-Lift Holder with Steel Tank.

For full particulars, address,

1505-4 "M.," care this Journal.

FOR SALE,

8-inch Rotary Exhauster, with by-pass and valves.
6-inch Dry Center Valve.
Scrubber, 3 feet by 16 feet.

All in good order. Apply to A. B. FARQUHAR CO., LTD.,

1505-1 York, Pa.

FOR SALE.

Water Gas Machine, Lowe, U. G. I. make, complete, excepting linings and checker-brick. This machine will make from 100,000 to 150,000 cubic feet in 24 hours.
One No. IV. Sturtevant Blower.
One 10-Horse Westinghouse Blower Engine.

Above all in good working order. Will sell cheap if taken at once.

MARSHALL GAS LIGHT CO.,

1504-5 MARSHALL, MICH.

J. F. W. JOST,
CHEMICAL ENGINEER
—IN—
GAS MANUFACTURE,

P. O. BOX 2043, PHILADELPHIA, PA.

Purimachos Gas Cement.

For Building, Repairing, Jointing and Glazing Clay, Brick or Iron Retorts.

For Building and Repairing Furnaces in or out of Action.

For Circulars, Address,

W. A. ROSS & BROTHER, 11 SO. WILLIAM ST., NEW YORK.

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BROWNHOIST CRANES
FOR LIFTING PURIFIER COVERS IN GAS HOUSES.

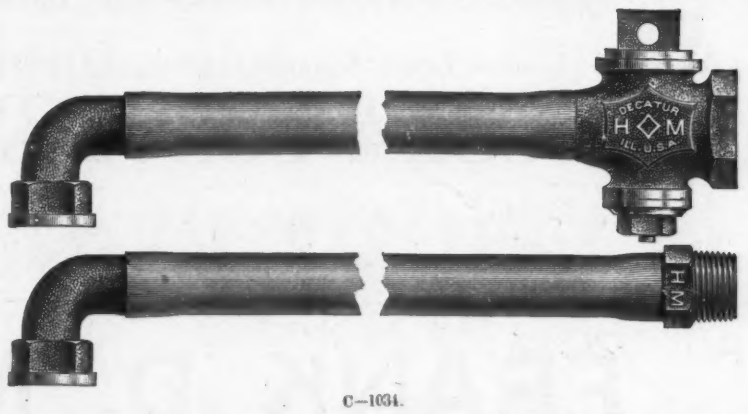
WRITE FOR PARTICULARS.

The Brown Hoisting Machinery Co.,

1436 St. Clair Street, Cleveland, O.

217 Havemeyer Building, New York.

Mueller Sweated Joint Meter Connections.



C—1034.

Gas Meter Connections, Lead, Sweated Joint. Fitted with bent meter couplings on one end and meter cock on the other.

Little economies here and there make a general economy that is very telling at the end of the season

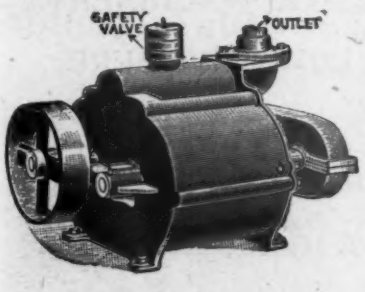
Mueller Sweated Joint Meter Connections are made cheaper than your men can make them, and they save a little on each meter installed. A season's total of these savings will make a very considerable difference in the income of your plant.

Mueller Sweated Joint Connections are made in six classifications, with 45 different sizes and specifications in each class. They are made with special pattern shouldered fittings sweated into the swedged lead pipe.

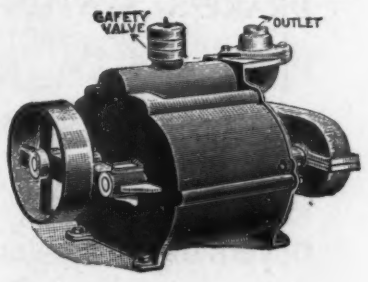
Each connection is given a working test before packing and is unconditionally guaranteed.

Mueller Meter Connections can be seen on exhibition at the MUELLER EXHIBIT on F street, between 4th and 5th streets, Palace of Manufactures, WORLD'S FAIR, ST. LOUIS, April 30 to December 1, 1904.

H. MUELLER MFG. CO., - DECATUR, ILLS., U. S. A.



REVIVIFYING IN SITU.



An inexpensive device for admitting air into purifying boxes. Belted direct to exhauster shaft the speed of blower is automatically regulated. Size shown in cut, 10 inches by 10½ inches by 16 inches, has a capacity of 172 cubic inches per revolution, and can be speeded to admit percentage of air desired. Specially designed for gas companies. A large number of these machines are now in daily use, giving entire satisfaction.

CORRESPONDENCE SOLICITED.

Connelly Iron Sponge and Governor Co.,

395 BROADWAY, NEW YORK CITY.

TELEPHONE, 3033 FRANKLIN. CABLE ADDRESS, GOVERNORCO.

PARKER-RUSSELL MINING AND MFG. CO.,

PROPRIETORS OF THE

OAK HILL GAS RETORT AND FIREBRICK WORKS.

St. Louis Office: 417 Pine Street. **New York Office:** Aldrich Court, 45 Broadway.

WE MAKE A SPECIALTY OF WATER GAS LININGS AND CHECKER BRICK.

Half and Full Depth Benches of Our Own Design, Containing 6, 8 or 9 Retorts.

SLOPERS.—We have perfected plans of INCLINED RETORT BENCHES, designed to meet conditions prevailing in America, and constructed entirely of American materials.

We Build Benches Complete, Ready for Gas Making. Also

RETORT HOUSES,

COAL and COKE CONVEYING MACHINERY.

Plans, Specifications and Estimates Cheerfully Furnished.

CORRESPONDENCE SOLICITED.

FRANK D. MOSES,

Long Distance Telephone, 1922, Trenton, N. J.

TRENTON, N. J.,

Long Distance Telephone, 1922 Trenton, N. J.

Constructing Engineer and Contractor.

Estimates Furnished on any kind of Work in Connection with Gas or Water Plants.

SPECIAL ATTENTION GIVEN TO THE REMODELLING AND EXTENDING OF THE PROPERTIES OF WORKS NOT UP-TO-DATE

CORRESPONDENCE SOLICITED.

GEO. G. RAMSDELL.

DRAKE'S SYSTEM OF INCLINED RETORTS. COAL AND COKE MACHINERY.

P. H. & F. M. ROOTS CO. GAS EXHAUSTERS, HIGH OR LOW PRESSURE.

AMMONIA CONCENTRATING PLANT.

AIR DEVICE for Admitting a Proper Percentage of Air into Purifying Boxes.

Governors, Gas Valves, Cast Iron Specials, Gauges, Photometers, Gas Specialties.

TELEPHONE, 3553 Spring. **530 BROADWAY, NEW YORK CITY.**

FREDERIC EGNER,

Gas Engineer,

WASHINGTON BANK BUILDING, 12TH & G STS., N. W., WASHINGTON, D. C.,

May be consulted with reference to estimates of cost for new, or appraising actual value of existing works; utility of proposed or patented processes; relative earning power to capitalization, and management. Will NOT undertake to furnish apparatus or material, or to contract for the erection of works.

Chollar's System of Gas Purification.

THE PURIFIED GAS REVIVES THE FOULED OXIDE.

THE HUMPHREY LIGHT is made in its entirety in our own shops.

Our lamp business is not a side issue jobbed out among various brass workers. We are the designers and makers of the original gas arc light.

GENERAL GAS LIGHT CO.,
KALAMAZOO, MICH.

54 Warren Street, New York.
530 Market Street, San Francisco.

ARTHUR R. CRUSE, President. FRANK FLAVELL, Secretary. AARON E. KEMPER, Treasurer.

Cruse-Kemper Company,

PHILADELPHIA OFFICES: Stephen Girard Building. - - WORKS: Ambler, Pa.

Manufacturers of

Triple, Double and Single-Lift Gasholders,

With or Without Metal Tanks,

Oil and Water Tanks, Purifier Covers, General Plate Metal Work, and Steel Water Towers.

Plans, Specifications and Estimates Promptly Furnished on Request.

COX'S HIGH-PRESSURE FLUID DISCHARGE COMPUTER.

This Computer solves the following formula, which is applicable to Gas, Air and other elastic fluids, flowing through long pipes with high initial pressures:

$$\text{Discharge in cubic feet per hour at atmospheric pressure} = 33.3\sqrt{\frac{d^5 \times (p_1^2 - p_2^2)}{L \times w}}$$

Where d = diameter of pipe in inches,
p_1 = absolute initial pressure in pounds per square inch,
p_2 = absolute terminal pressure in pounds per square inch,
L = length of pipe in miles,
w = specific gravity of the fluid when air = 1.

To Find the Discharge from a Pipe and the Required Size of Pipe.

(1.) Set the specific gravity of the fluid opposite the length of pipe;
(2.) Bring the DIFFERENCE of the initial and terminal gauge pressures opposite the SUM of the initial and terminal gauge pressures;
(3.) Opposite any diameter of pipe will now be found the discharge in cubic feet per hour at atmospheric pressure; and
(4.) Opposite any desired discharge will also be found the required diameter of pipe.

Price of the Computers, in Cloth Case, 6½ x 8 inches, $5 Each, Net.

A. M. CALLENDER & CO., 42 PINE ST., N. Y.

HOW MUCH GAS DO YOU SELL IN EUROPE?

Why should **you** use foreign made burners or tips? We make as good union jet checked burners as money can buy. Let us send you samples before you order any more imported goods in this line. **Special Offer.**—A sample cake of Stainoff free with samples of Steward Lava Tips or Steward Burners. This offer to Gas Companies only.

D. M. STEWARD MFG. CO., Est. 1876, **CHATTANOOGA, TENN., U. S. A.**

P. PLANTINGA PRES. THE W.E. STEINWEDELL SEC.

GAS MACHINERY CO.,

MAIN OFFICE AND SHOPS

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ROTARY SCRUBBERS,
WASHERS,
BY PRODUCT MACHINERY.
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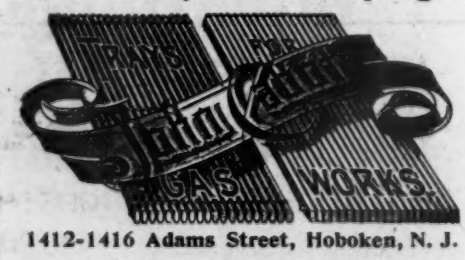
Reversible; Strongest; Most Easily Repaired.

Special Trays for Iron Sponge.



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not necessarily better on that account, but the Yankees do, once in a while, make improvements. The phenomenal success of this attachment proves its worth. Simple. Accurate. Price gear can be set to deliver **EXACT** amount at any rate gas. Long warning to consumers. Other important features.

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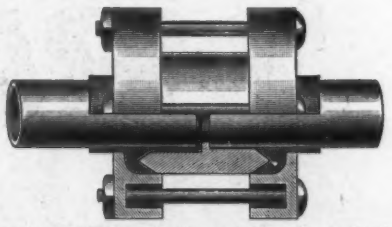
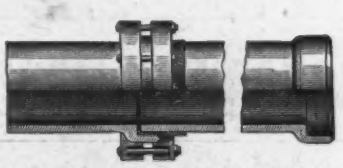
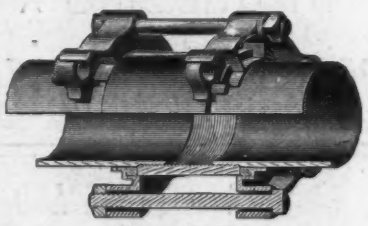


Insulating Coupling for Wrought Iron Pipe. Style 5.



Insulating Coupling for Dresser Bell and Spigot Cast Iron Pipe. Style 6.

Regular Sleeve. Style 2.



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Clamps for Cast Iron Pipe. Style 4½.

Pipe Couplings, Sleeves, Clamps, Crosses, Tees and Ells.

My insulating Coupling prevents the destruction of pipe by electrolytic action, in either water or gas lines.

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in boiler house of Allegheny City Water Works. A very satisfactory type, popular in power houses and factories.

The installation of Link Belt Elevators and Conveyors marks a distinct advance in the economy and efficiency of any plant.

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Economize Heat in Water Gas Plants,

BY UTILIZING A

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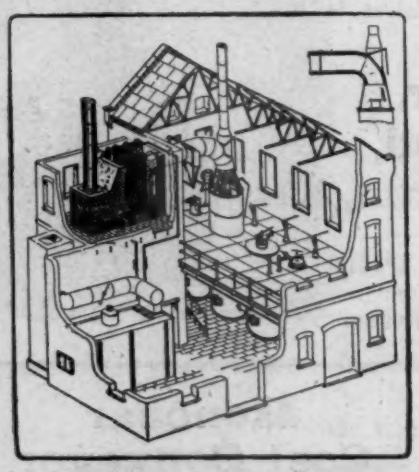

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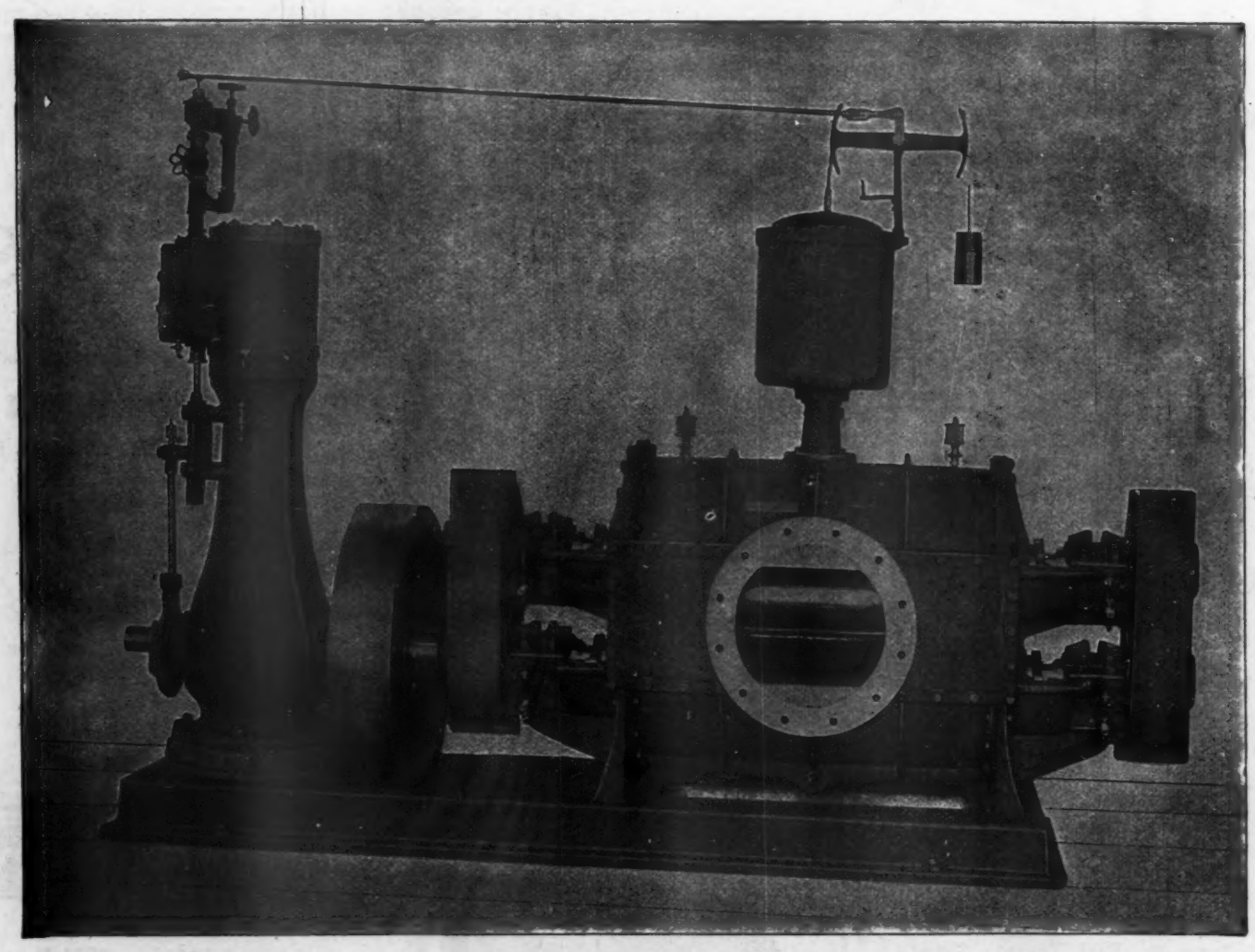
OUR GAS GOVERNOR IS MAKING FRIENDS EVERY DAY.



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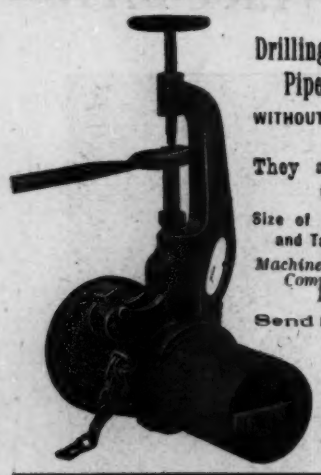
Drilling and Tapping Pipe under Pressure

WITHOUT ANY ESCAPE OF GAS.



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With our experience, ability and facilities we produce

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Perfect workmanship.
Highest efficiency.
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FOR WIDE BELTS.
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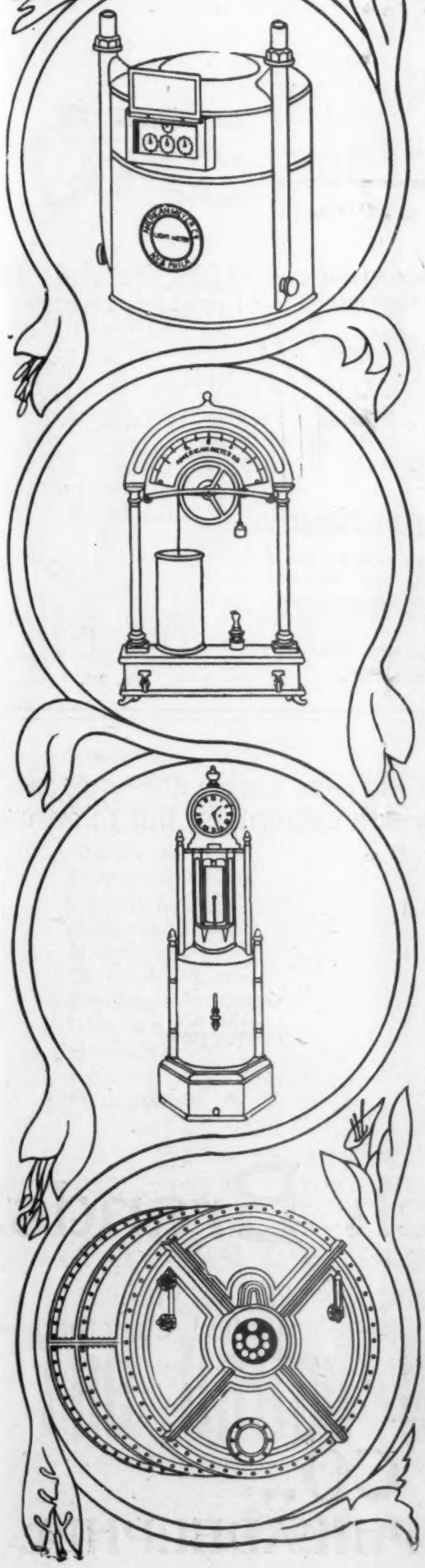
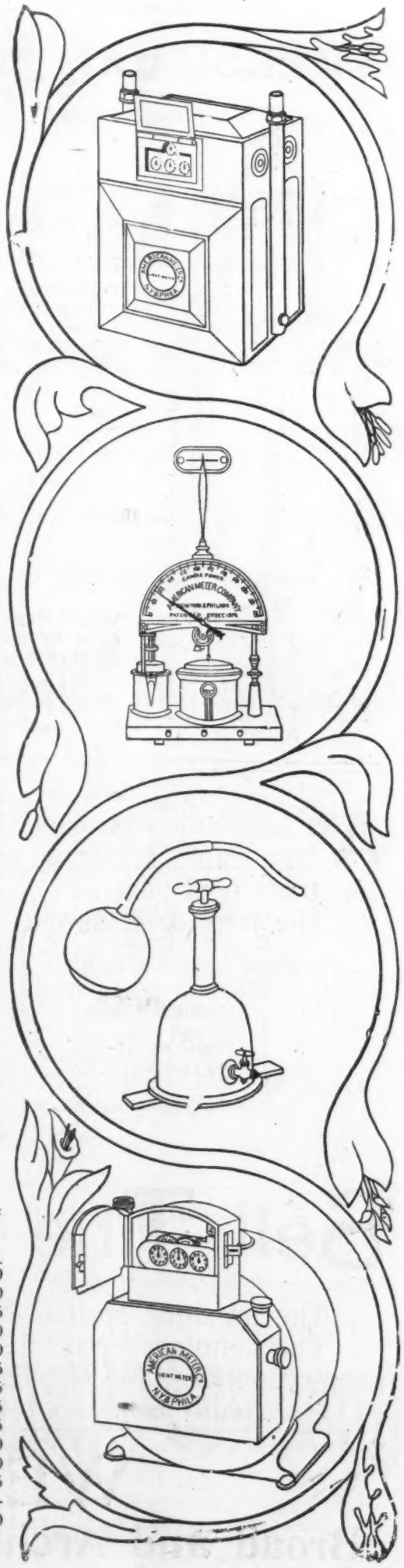




PUBLIC LIGHTING TABLE.

APRIL, 1904.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Fri.	1	6.50 PM	9.00 PM	6.10	4.55
Sat.	2	6 50	10.00	6.15	4.40
Sun.	3	7.00	11.10	6.15	4.40
Mon.	4	7.00	12.10 AM	6.15	4.40
Tue.	5	7.00	1.00	6.15	4.40
Wed.	6	7.00	1.50	6.15	4 40
Thu.	7	7.00 LQ	2.30	6.15	4.40
Fri.	8	7.00	3.10	6.15	4.40
Sat.	9	7.00	3.50	6.25	4.30
Sun.	10	7.10	4.20	6.25	4.30
Mon.	11	7.10	4.30	6.25	4.20
Tue.	12	7.10	4.30	6.25	4.30
Wed.	13	7.10	4.30	6.25	4.30
Thu.	14	7.10	4.30	6.25	4.30
Fri.	15	7.10 NM	4.30	6.25	4.30
Sat.	16	7.10	4.30	6.30	4.20
Sun.	17	7.10	4.20	6.30	4.20
Mon.	18	7.10	4.20	6.30	4.20
Tue.	19	7.10	4.20	6.30	4.20
Wed.	20	10.30	4.20	6.30	4 20
Thu.	21	11.20	4.20	6.30	4.20
Fri.	22	12.10 AM FQ	4.20	6.30	4.20
Sat.	23	12.50	4.20	6.40	4.10
Sun.	24	1.30	4.10	6.40	4.10
Mon.	25	2.10	4.10	6.40	4.10
Tue.	26	2.50	4.10	6.40	4.10
Wed.	27	3.30	4.10	6.40	4.10
Thu.	28	No L.	No L.	6.40	4.10
Fri.	29	No L. FM	No L.	6.40	4.10
Sat.	30	No L.	No L.	6.45	4.00

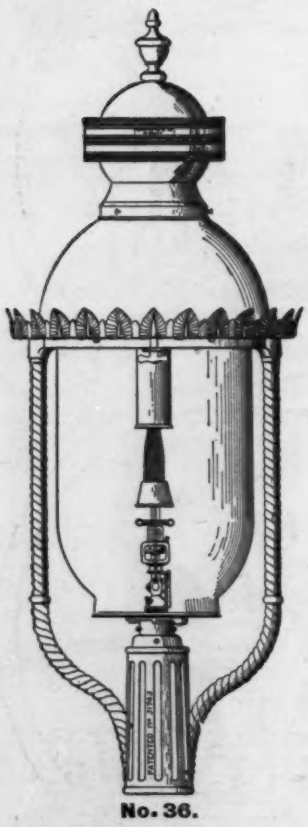
TOTAL HOURS LIGHTING DURING 1904.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	225.00	January	423.20
February	205.40	February	367.40
March	187.40	March	355.35
April	169.50	April	298.50
May	152.30	May	264.50
June	137.20	June	234.25
July	138.50	July	243.45
August	151.00	August	280.25
September	164.40	September	321.15
October	191.30	October	374.30
November	210.30	November	401.40
December	237.10	December	433.45
Total, yr.	2171.40	Total, yr.	4000.00

NEW YORK, 33 Nassau Street. BOSTON. 814 Beacon Building. PHILADELPHIA, Bread and Arch Streets. ST. LOUIS, 712 Roe Building. CHICAGO, Foot of Orleans Street. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



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IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

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AN underlying principle in business is to show an increase each year---to grow. The astute dealer not only seeks to retain this year's customers, but to attract new trade next year.

The formula is simple-

THIS SHIELD IS THE WELSBACH TRADE MARK.

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Sell The Welsbach Brands.

The imitation stuff is bad for the customer---which is bad for you.

The genuine Welsbachs---Burners or Mantles---make satisfied customers---keep customers---MAKE NEW ONES.

And your profit isn't merely dollars and cents.

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For the Year Ending December 31, 1903. has been Awarded Contracts in the Following Places for

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Baltimore, Md.	Lynn, Mass.	New York (Central Union Co.)
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Amesbury, Mass.	Washington, D. C.	Chicago (Ogden Co.)
Aberdeen, S. D.	Boone, Ia.	Easton, Pa.
Winsted, Conn.	Pueblo, Col.	Lawrence, Mass.
Canon City, Col.	Charlotte, N. C.	Council Bluffs, Ia.
Schenectady, N. Y.	Fall River, Mass.	Chattanooga, Tenn.
Hagerstown, Md.	Duluth, Minn.	Tuckerton, N. J.
Malden, Mass.	New York (Mutual Co.)	Springfield, O.
Bridgeport, Conn.	Waltham, Mass.	Easton, Pa. (2d contract).
Albert Lea, Minn.	Dover, Del.	Mobile, Ala.
Brooklyn, N. Y.	York, Pa.	Conshohocken, Pa.
Kansas City, Kas.	Minneapolis, Minn.	Mason City, Ia.
Hempstead, N. Y.	Allentown, Pa.	

TOTAL SETS FOR 1903, ... 62
TOTAL DAILY CAPACITY, ... 62,950,000 cubic feet.
TOTAL SETS TO DATE, ... 508
TOTAL DAILY CAPACITY, ... 362,780,000 cubic feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
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Fire Brick, Tiles, Etc.

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In Kegs, 100 to 200 " " 6 " "
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For orders East of Buffalo, N. Y., or Pittsburg, Pa., freight will be paid to these points.

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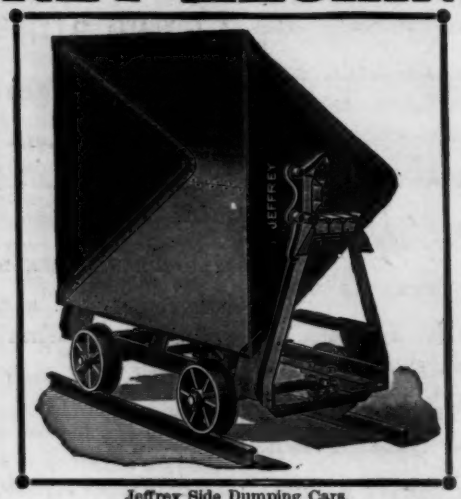

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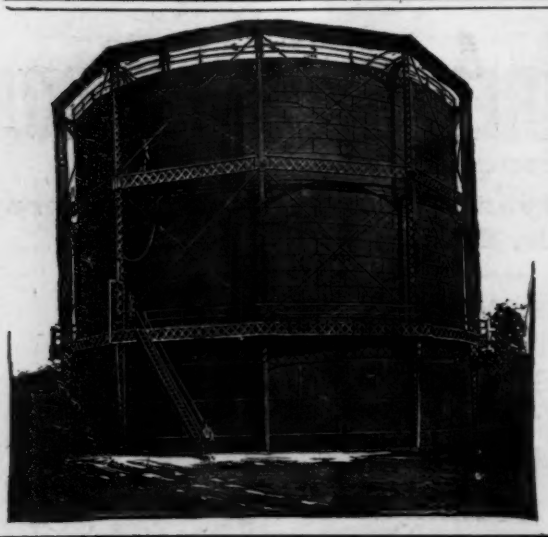

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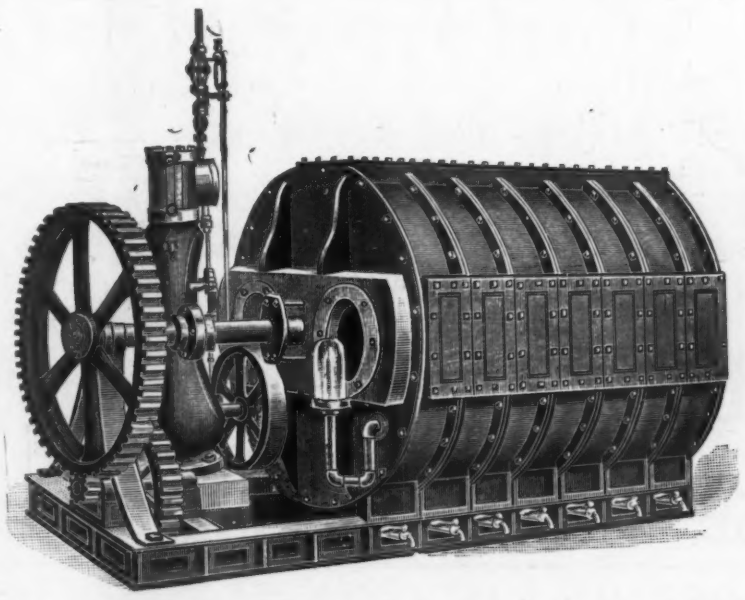

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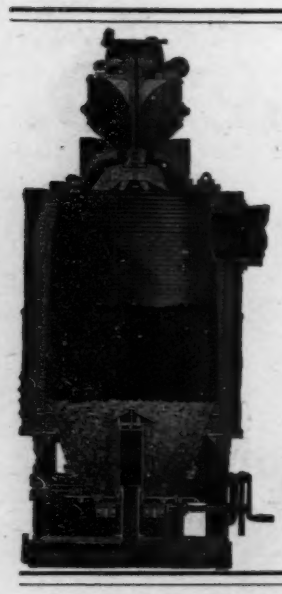

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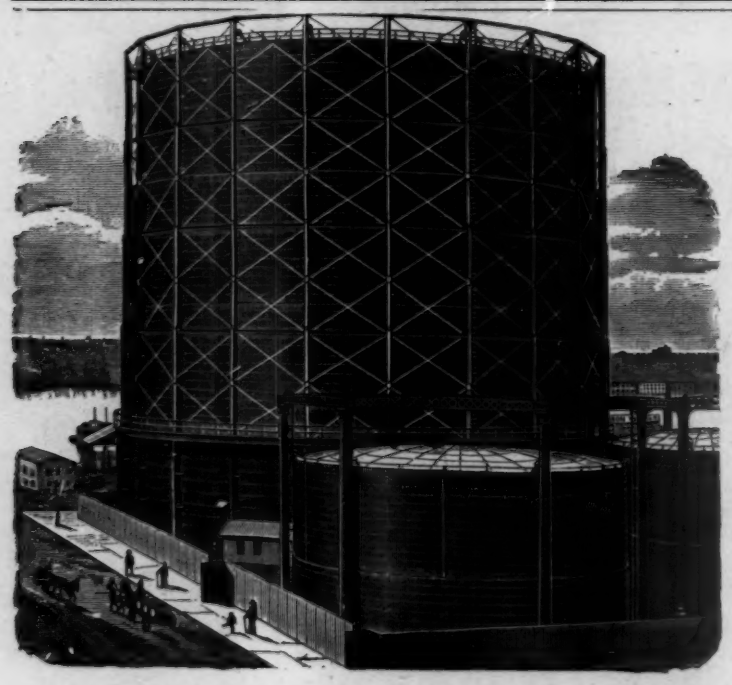

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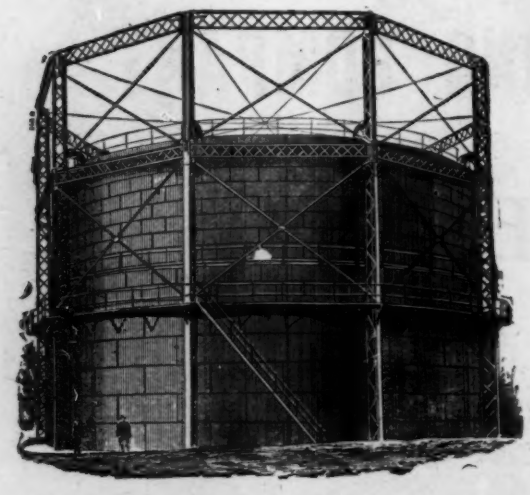

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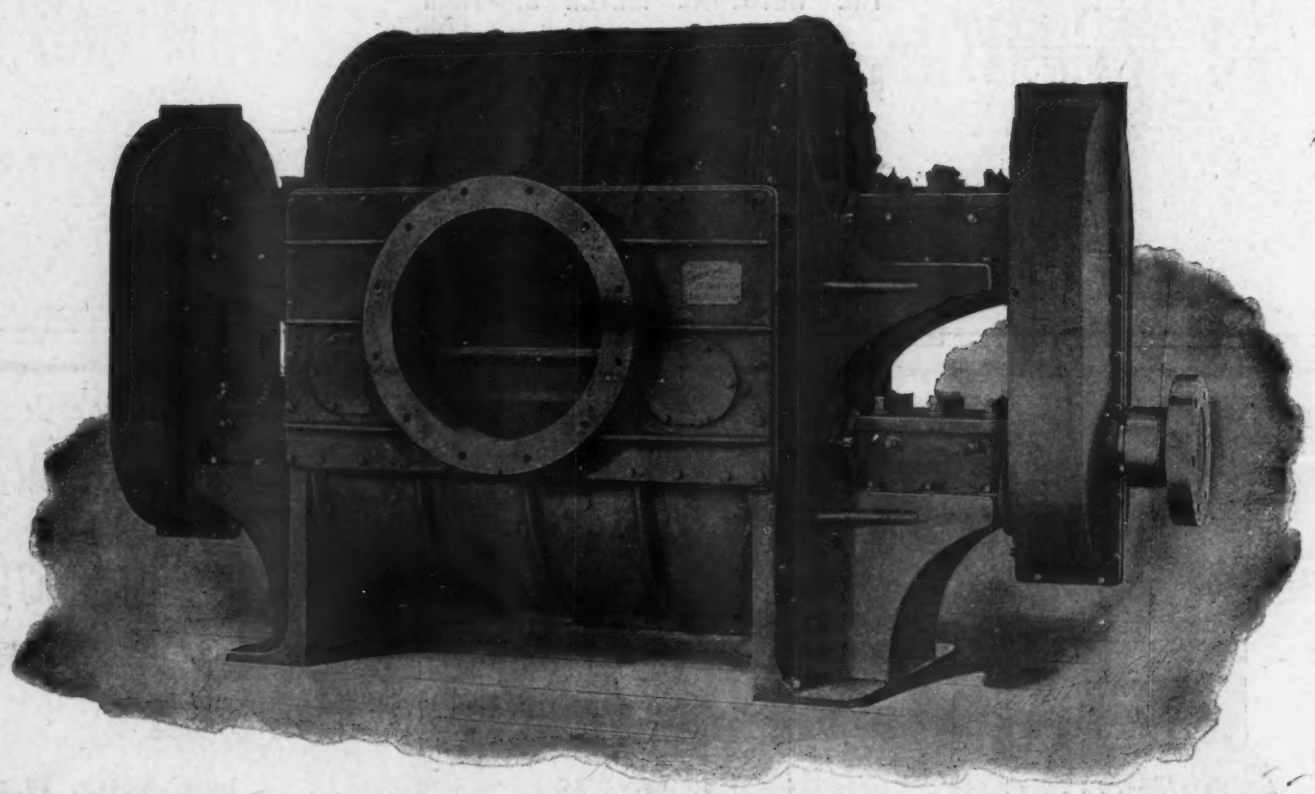

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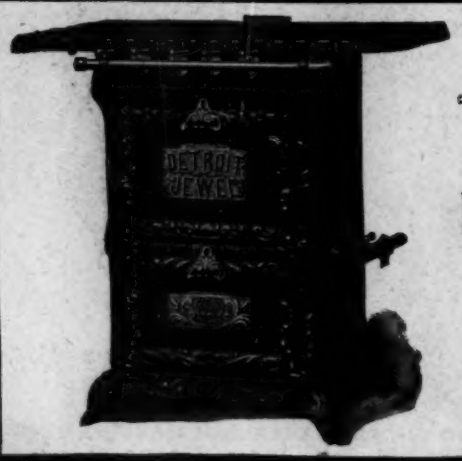

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